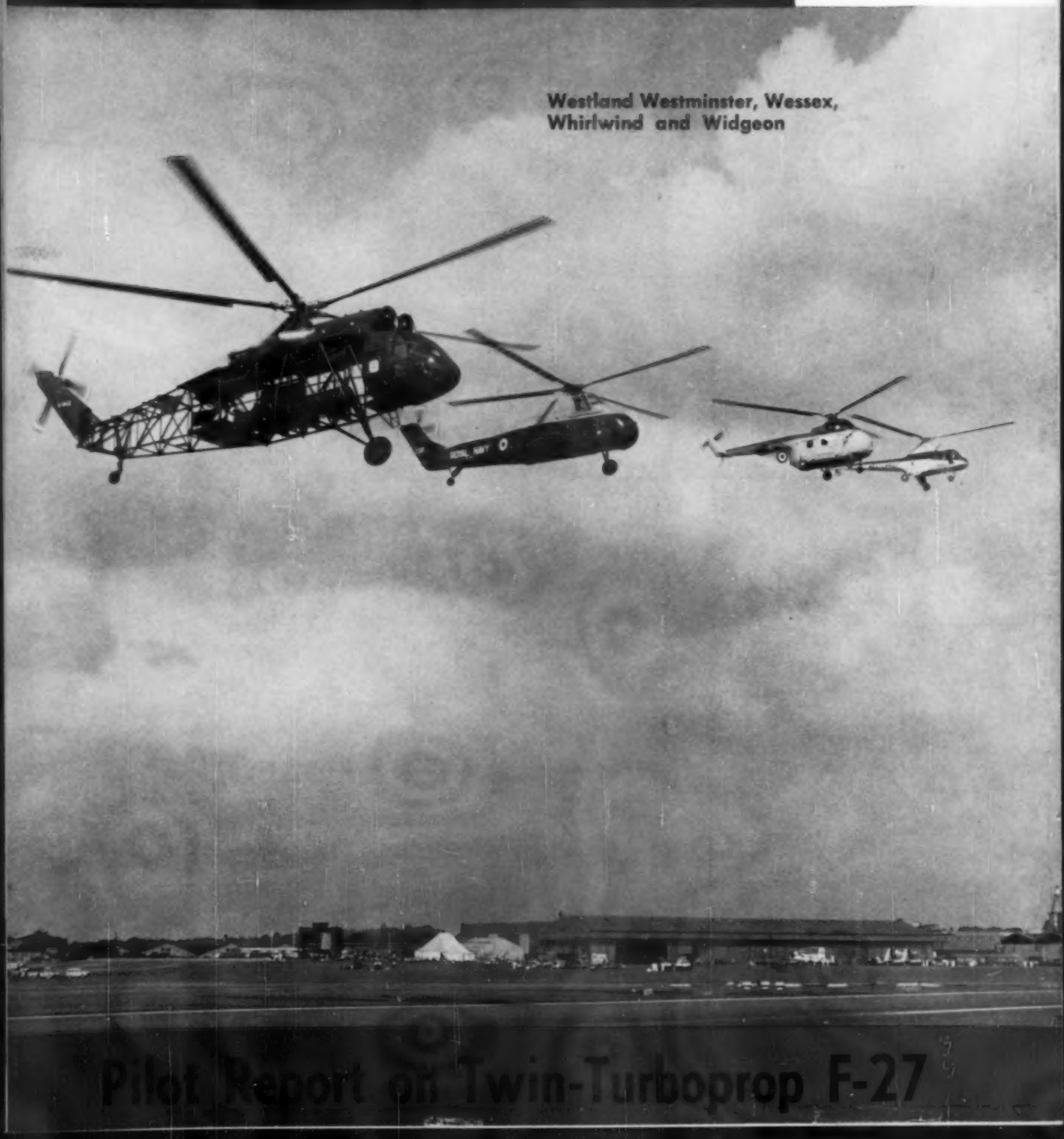
Aviation Week

Including Space Technology

A McGraw-Hill Publication

September 15, 1958

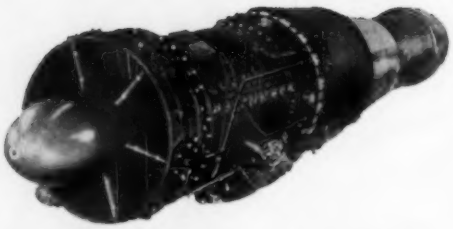
Combat-Ready Snark Enters SAC Inventory



Westland Westminster, Wessex, Whirlwind and Widgeon

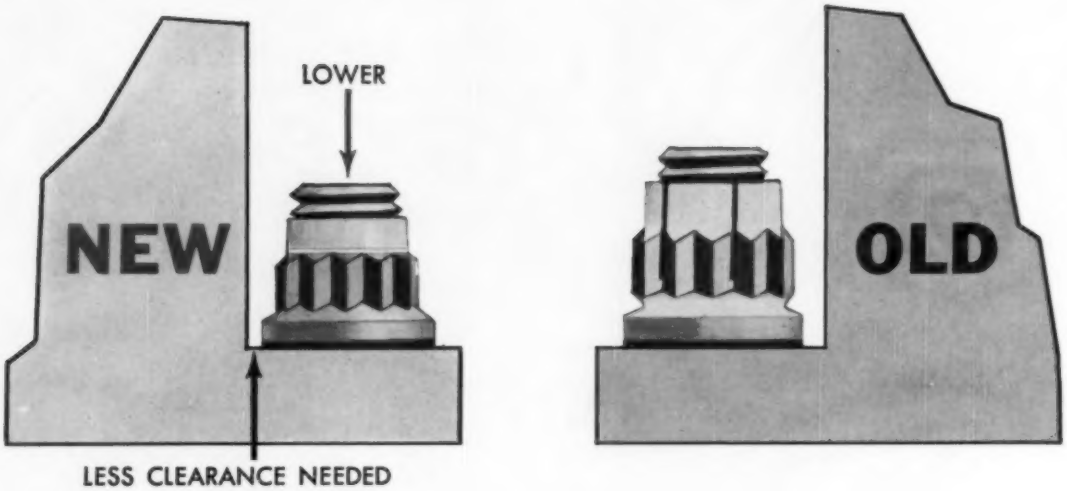
Pilot Report on Twin-Turboprop F-27

on modern jet engines....



NEW KAYLOCK HIGH TEMP NUTS

cut weight – save space



Where do you start trimming excess weight off the sleek power plants on our modern aircraft?

Kaylock has the answer for your engine design team. It's a new high temp, self-locking nut that is *55% lighter and smaller*, yet full tensile strength.

The Kaylock H33—first lightweight, high temp nut designed especially for jet engines—has other significant weight and space saving advantages. Low height—permits use of shorter thread bolts. Installed with smaller wrenches closer to load center line—permits use of narrower, lighter flanges.

Precision-engineered of A286 corrosion-resistant steel, this revolutionary 12-point self-locking nut is for use in temperature ranges to 1200°F. It's another Kaylock original—from the world's largest manufacturer of lightweight, self-locking nuts for airframes.

Special H33 configurations can be made to your specifications. WRITE TODAY for complete information and qualification test data. Better yet, ask to have a Kaylock Consultant call on you soon.

Setting Standards of Progress

FIRST on Airframes!
Now—FIRST on Jet Engines with lightweight, self-locking nuts!

New Kaylock H33

KAYLOCK®
Trade Mark
all-metal self-locking nuts

KAYNAR MFG. CO., INC. • KAYLOCK DIVISION • Los Angeles, California • Wichita, Kansas • New York, N.Y. • Canadian distributor: Abercorn Aero Ltd., Montreal, Quebec • Or write: Executive Offices, Box 2001, Terminal Annex • Los Angeles 54, California.

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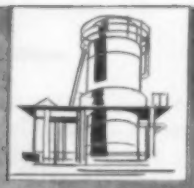

Huge rocket case furnaces

Complete design facilities for development or production

Steel—or fiber-glass—rocket cases for weight-savings

Quality control—by X Ray, hydrostatic and complete metallurgical test equipment

Thrust axis engineered to watchmaker's precision

10-year experience harnesses the high specific impulse of newest solid propellants

Foresight with a wallop!

Foresight which saw the coming of the Space-and-Missile Age enabled Goodyear Aircraft Corporation to begin construction—*more than ten years ago*—of what is today one of the most advanced and largest integrated rocket engine case facilities in the nation.

Furnaces—among the largest ever built for the task—spawn these exacting space-conquering units. Experienced technicians, backed by batteries of test equipment, control the quality of the materials—insure the soundness of each weld—maintain tolerances to thousandths of an inch.

This foresight, these skills, this equipment have made Goodyear Aircraft the birthplace of more large-size rocket engine cases than any other producer.

For more information on this completely integrated facility, write Goodyear Aircraft Corporation, Dept. 916AU, Akron 15, Ohio.

ROCKET ENGINE CASES—One of the Prime Capabilities of

GOODYEAR AIRCRAFT

Plants in Akron, Ohio, and Litchfield Park, Arizona

RELIABLE

QUALIFICATION TESTING

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Partial view of environmental testing facility

ADEL is equipped to handle your environmental testing requirements to many specifications, including MIL-E-5272.

Benefit by ADEL's unmatched experience, engineering skill, technical background and modern facilities.

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DESIGNERS, DEVELOPERS, MANUFACTURERS AND TESTERS OF AIRCRAFT AND MISSILE HYDRAULIC, PNEUMATIC, FUEL, MECHANICAL AND ELECTRICAL EQUIPMENT . . . . . .

AVIATION CALENDAR

Sept. 22-24—1958 Convention of the National Business Aircraft Assn., Bellevue Stratford Hotel, Philadelphia, Pa.

Sept. 22-24—1958 Meeting, Professional Group on Telemetry and Remote Control, Americana Hotel, Bal Harbor, Miami Beach, Fla.

Sept. 23-25—Radio Technical Commission for Aeronautics, Fall Assembly Meeting, Chamberlain Hotel, Old Point Comfort, Ft. Monroe, Va.

Sept. 25-27—Fifth Annual National Western Forum, American Helicopter Society, Ambassador Hotel, Los Angeles, Calif.

Sept. 25-28—Air Force Assn. Annual Convention and Airpower Panorama, Dallas.

Sept. 29-30—Mid-Year Conference, Airport Operators Council, Mayo Hotel, Tulsa.

Sept. 29-Oct. 3—National Aeronautical Meeting, Society of Automotive Engineers, Ambassador, Los Angeles, Calif.

Sept. 29-Oct. 3—Semi-Annual Meeting and Western Tool Show, American Society of Tool Engineers, Shrine Exposition Hall, Los Angeles, Calif.

Oct. 1-3—National Airports Conference, University of Oklahoma, Norman, Okla. Co-sponsored by American Assn. of Airport Executives and the CAA.

Oct. 2-4—Professional Pilots' Symposium on Air Space Safety, Society of Experimental Test Pilots, Beverly-Hilton Hotel, Beverly Hills, Calif.

Oct. 4—Second Annual Awards Banquet, Society of Experimental Test Pilots, Beverly Hilton Hotel, Beverly Hills, Calif.

Oct. 6-7—National Symposium on Extended Range and Space Transmission, sponsored by Institute of Radio Engineers and George Washington University, Lisner Auditorium, Washington, D. C.

Oct. 7-8—1958 Joint Meeting, Institute of the Aeronautical Sciences and Canadian

(Continued on page 6)

AVIATION WEEK Including Space Technology

September 15, 1958
Vol. 69, No. 11

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Progress in the Science of Chronometry

IN 1714, the British government offered a prize of £20,000 for any means of determining a ship's longitude within 30 nautical miles at the end of a six week's voyage. John Harrison, a self-educated Yorkshire carpenter, won the prize in 1760 with an accurate clock.

IN 1958, ICBMs and earth satellites created the need for new concepts in accurate timing. To fill this need, Hycon Eastern has developed an electronic Timing System with heretofore unattainable timing precision capable of operating anywhere in the world.

AN INTEGRATED TIMING SYSTEM FOR TODAY'S GLOBAL CONCEPTS

Solar or sidereal time is displayed visually and is available for input to automatic computers and indexing data with many types of recorders . . . magnetic tape, oscillograms, photographs and strip charts. Furnishing a time scale with resolutions available to one microsecond, this system is ideally suited for tracking and control of missiles, astronomical measurements, and navigation systems. Write for Bulletin TS-00.

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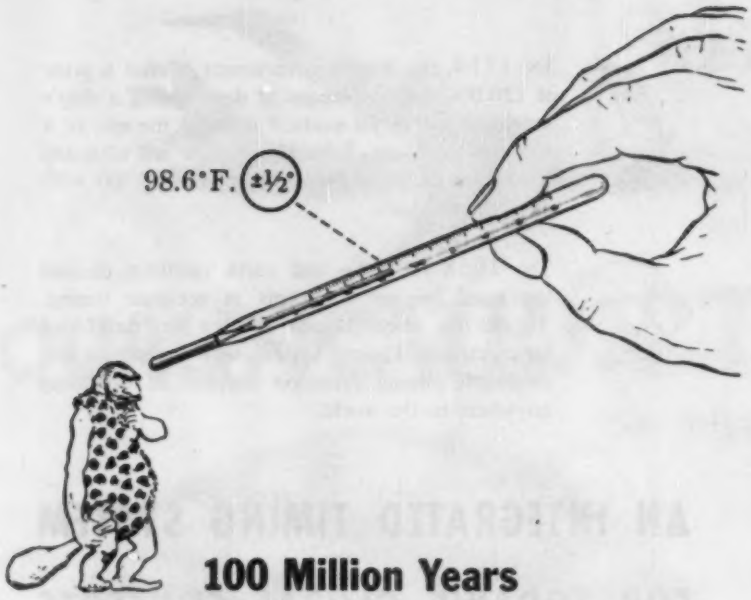


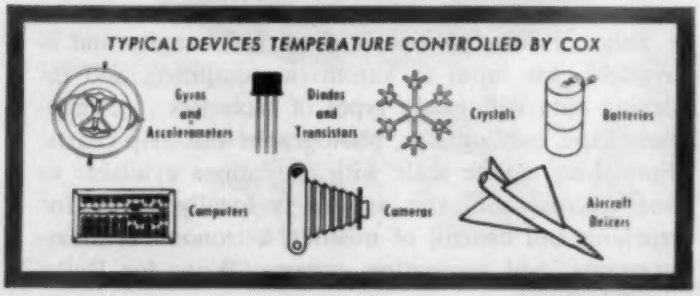
100 Million Years for System Development of Man's Marvelous Temperature Control

COX SYSTEMS GIVE CLOSER CONTROL WITH ULTRA-RELIABLE, FAIL-SAFE ELECTRIC HEATERS

Cox has designed more than 2000 different successful temperature control installations.

Cox has delivered more than 300,000 units for military service.

ADVANCED THERMAL ENGINEERING
plus
COMPLETE LABORATORY FACILITIES
plus
PRODUCTION CAPABILITY



The Tougher the Problem...The Better We Like It!

COX & COMPANY, INC.

115 EAST 23 STREET **NEW YORK 10, N.Y.**

Engineering Representatives in Most Areas

AVIATION CALENDAR

(*Continued from page 5*)

Aeronautical Institute, Chateau Laurier, Ottawa, Canada.

Oct. 8-10—14th Annual Aviation Spark Plug and Ignition Conference, Champion Spark Plug Co., Secor Hotel, Toledo.

Oct. 9-10—Ninth Annual National Noise Abatement Symposium, sponsored by Armour Research Foundation, Hotel Sherman, Chicago, Ill.

Oct. 13-15—ASME-ASLE Joint Lubrication Conference, Statler Hotel, Los Angeles, Calif.

Oct. 13-15—14th Annual National Electronics Conference, Hotel Sherman, Chicago, Ill.

Oct. 15-17—Twelfth Annual Meeting Southeastern Airport Managers' Assn., The Palm Beach Terrace, Palm Beach.

Oct. 20-21—Fourth National Aero-Com Symposium, sponsored by Institute of Radio Engineers, Hotel Utica, Utica, N. Y.

Oct. 20-22—1958 Annual Meeting, Assn. of the United States Army, Sheraton-Park Hotel, Washington, D. C.

Oct. 20-22—National Safety Congress and Exposition, Aeronautical Industries Section, National Safety Council, Conrad Hilton Hotel, Chicago, Ill.

Oct. 22-24—Fifth National Vacuum Symposium, Sir Francis Drake Hotel, San Francisco, Calif.

Oct. 23-25—1958 National Simulation Conference, sponsored by Institute of Radio Engineers Professional Group on Electronic Computers, Statler-Hilton Hotel, Dallas, Tex.

Oct. 27—14th Annual General Meeting of the International Air Transport Assn., New Delhi, India.

Oct. 27-28—East Coast Conference on Aeronautical & Navigational Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

Oct. 30-31—1958 Electron Devices Meeting, sponsored by Institute of Radio Engineers, Shoreham Hotel, Washington, D. C.

Nov. 6-7—Quarterly Regional Meeting, Assn. of Local & Territorial Airlines, Honolulu, Hawaii.

Nov. 6-7—Fifth Annual Meeting, Institute of Radio Engineers Professional Group on Nuclear Science, Villa Hotel, San Mateo, Calif.

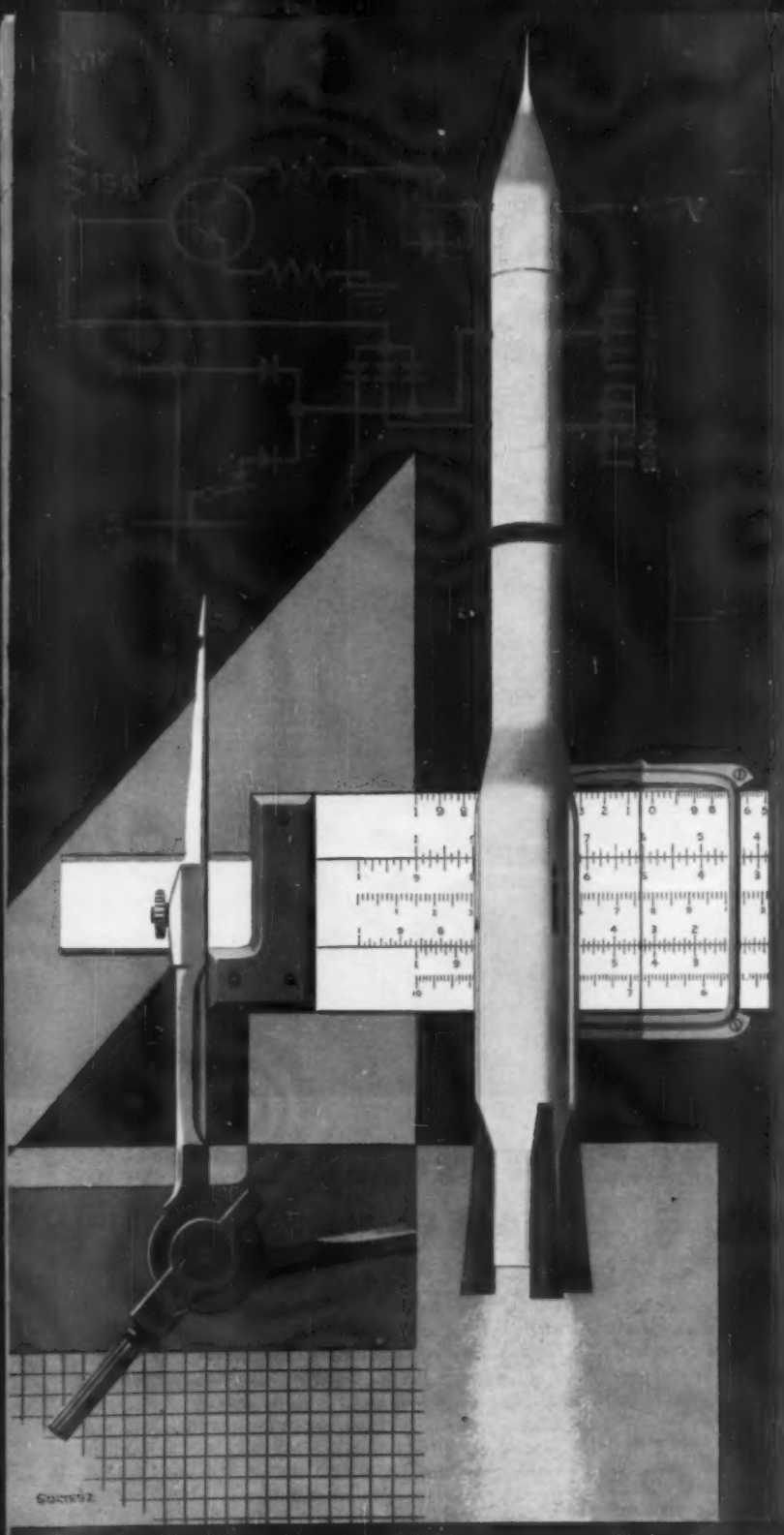
Nov. 6-7—National Specialist Meeting on Dynamics and Aeroelasticity, sponsored by Institute of the Aeronautical Sciences, Texas Section, Texas Hotel, Ft. Worth, Tex.

Nov. 10-12—International Conference, Physics and Medicine of the Atmosphere and Space, sponsored by the School of Aviation Medicine, San Antonio, Tex.

Nov. 10-13—11th Annual International Air-Safety Seminar, Flight Safety Foundation in cooperation with Airways Modernization Board's National Aviation Facilities Experimental Center, Atlantic City, N. J.

Nov. 17-21—13th Annual Meeting and Astronautical Exposition, American Rocket Society, Hotel Statler, New York, N. Y.

Nov. 19-21—32nd Meeting, Aviation Distributors and Manufacturers Assn., Statler Hilton Hotel, Dallas, Tex.



From layout to launching pad... Crosley

Only the most highly developed and technically proficient industrial organization can keep apace with America's swiftly changing defense needs. Crosley is such an organization—efficient, experienced, esteemed.

Crosley creative systems management insures speed and discipline during every phase of every project—no matter how complex.

Its extensive design and manufacturing facilities include advanced techniques in stainless-steel contour honeycombing, metal bonding, and chemical milling.

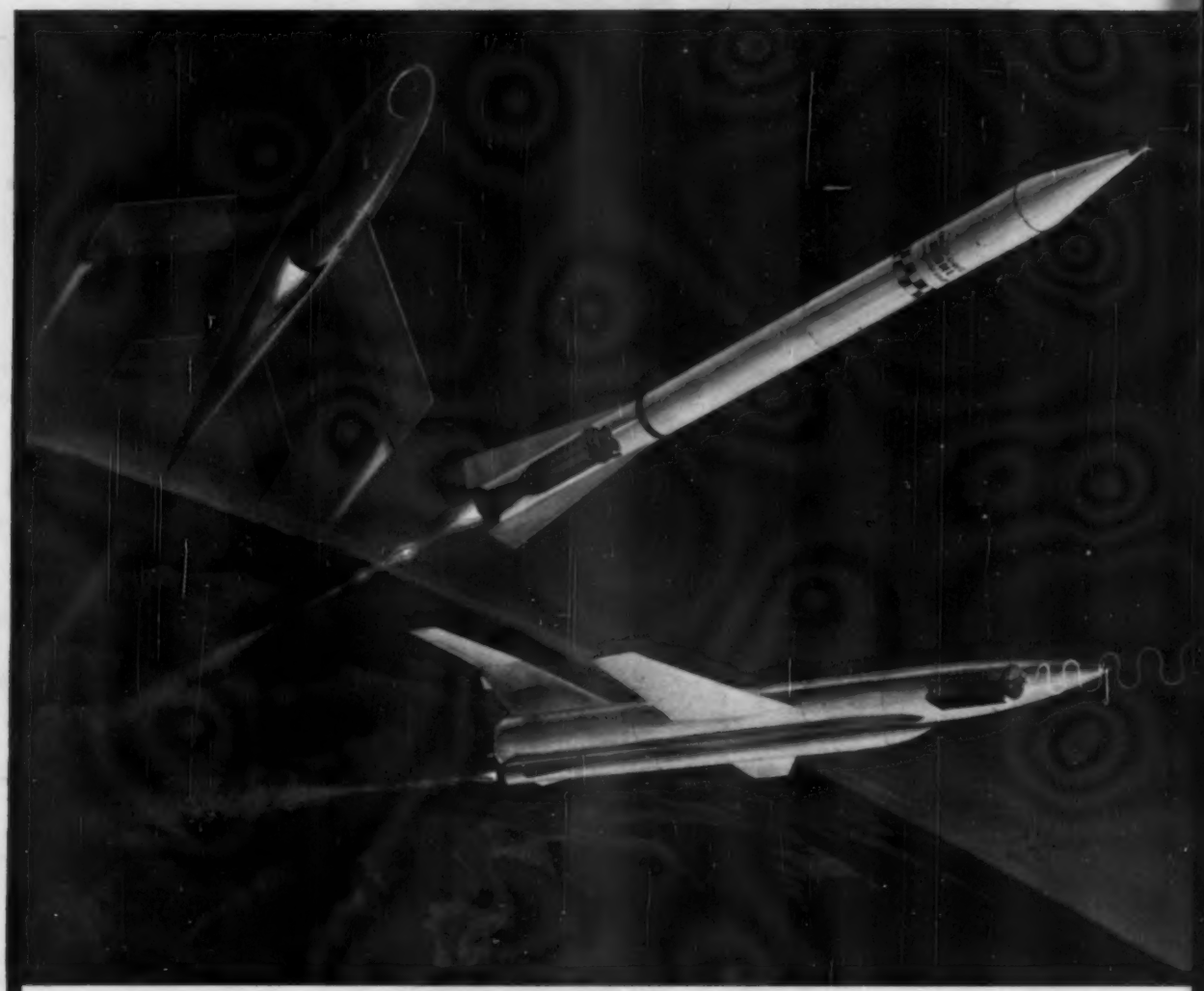
This combination of creativity and technical know-how has already proved itself in many defense projects: in Crosley's MD-9 fire control system, in its *Falcon* air-to-air missile components, in its research and development of the *Volscan* air traffic control system, in fuzing mortars, shells and missiles.

Avco-Crosley Missile Capabilities

Complete facilities for research, development, and engineering design of: *nose cones, air frames, electronics control systems, telemetering, automatic test and support equipment, ground handling equipment and logistics.* Production and manufacture of complete missile weapons.

For further information, write to: Vice President, Defense Products Marketing, Crosley Division, Avco Manufacturing Corporation, Cincinnati 25, Ohio.

Avco / Crosley



RYAN HAS YEARS OF EXPERIENCE IN MISSILE DESIGN, GUIDANCE, PROPULSION

Modern missiles have not only changed the concepts of global strategy – but also the concepts of heat, speed and power. The incredible fuel consumptions, accelerations and temperatures of these man-made meteors have made manufacturing methods obsolete. Tiny imperfections can cause a missile to run amok through violent, unstable combustion or wildly erratic guidance. Ryan is skilled in meeting the demanding precision of missile fabrication because Ryan has years of experience in designing, guiding and powering missiles.

DESIGN – Complete development of the Firebee jet drone missile – aerodynamic and systems design, quantity manufacture, and field service. The Firebee is in volume production for use by the Air Force, Navy and RCAF. Ryan has also carried out extensive research on air-launched vehicles and is engaged on a new project for an advanced type nuclear weapon delivery system.

GUIDANCE – Development of advanced military radar systems for supersonic missile guidance; RANAV (Ryan Automatic Navigation) Doppler systems; and ground speed indicators and hovering devices for helicopters, airships, and VTOL aircraft. Ryan is a pioneer in continuous-wave radar techniques.

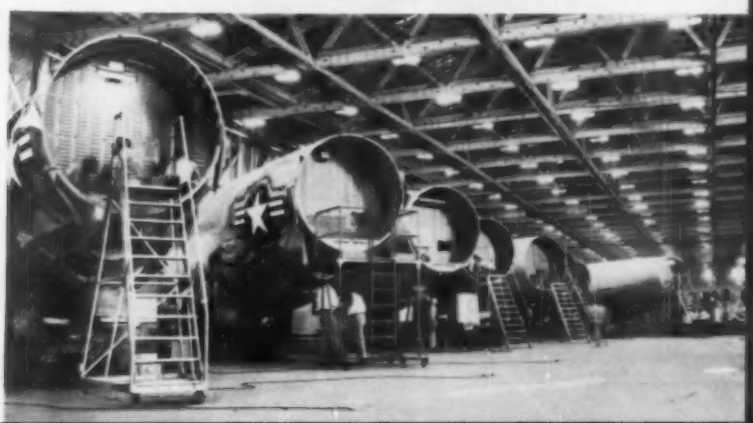
PROPULSION – Manufacture of powerful liquid rocket motors for surface-to-surface missiles; ramjet combustion chambers for ground-to-air missiles; and major high temperature components used by turbojet-powered missiles.

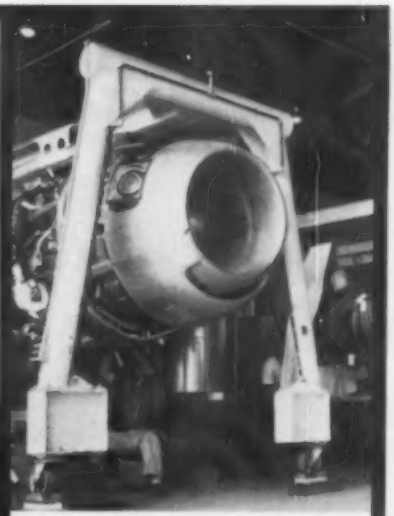
RYAN BUILDS ONE-HUNDREDTH BOEING JET TANKER AFT FUSELAGE

Huge aft fuselage sections for Boeing KC-135 jet tankers are now rolling off the Ryan production line at the rate of 15 a month.

Production of the giant airframe structures is well past the 100 mark, and ahead of schedule.

Ryan and Boeing have been in production partnership for more than 10 years. Ryan also built 888 fuselage sections and refueling pods, external wing fuel tanks and other components for the KC-135's predecessor, the piston-engined KC-97. The KC-97 production line met "on schedule" deliveries for seven years.





PACKAGED POWER FOR DOUGLAS DC-8s

Complete jet engine pods and supporting wing pylons for the new Douglas DC-8 Jetliners are now entering full production at Ryan. Ryan has been a major producer of equipment for military and commercial power plants since 1938.

VERTIJETS® CAN GIVE U.S. THE ADVANTAGE IN AIR POWER

Unlike conventional jets, Ryan's Vertijet is not dependent on vulnerable runways and air bases. It can be widely dispersed in rough terrain or forests, or in underground "foxholes."

This revolutionary craft takes off and lands straight up and down on jet thrust. Combat Vertijets will be more maneuverable and faster than conventional jet fighter-bombers, more mobile and accurate than ground-to-air missiles.

"Such vertical take-off jets can give us a tactical advantage never before realized," says a top expert on air power, "...as revolutionary a change in tactics and strategy as the jet engine itself."

®REGISTERED TRADEMARK

RYAN BUILDS BETTER

AIRCRAFT • POWER PLANTS • ELECTRONICS

Ryan Aeronautical Company, San Diego, Calif.

Test your cross-country memory

Can you name this airport?

Clue: *the citrus fruit center it serves is the spring training site of the Washington Senators baseball team. (Answer below)*

Now test your aviation oil memory: Do you remember the two important reasons why Gulf oils are better for your engine?

1. In addition to providing efficient, thorough lubrication, Gulf aviation oils help keep engines *clean*—and safe!

2. Gulf-clean engines can go longer between overhauls, because there's less wear and tear on engine parts.

Choose either new Gulfpride Aviation Oil Series D, the detergent oil, or Gulf Aircraft Engine Oil, the straight mineral oil—both keep your engine Gulf-clean and safe.

The airport pictured above is the Orlando, Florida Municipal Airport, two-and-half miles east of the city. It has five paved runways, the longest of these being 5,500 feet.

Here you'll find friendly Gulf service under the supervision of Howard Showalter, president of Showalter Flying Service.

GULF

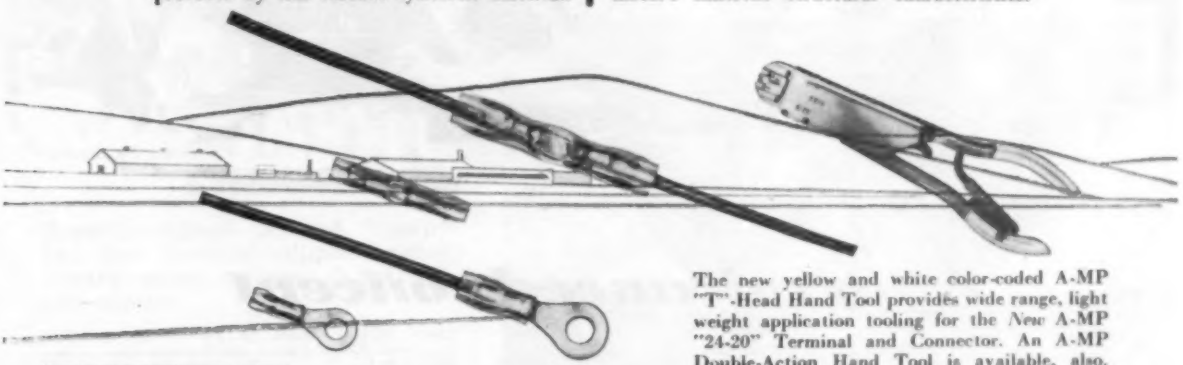
AVIATION PRODUCTS

Fly safely with a Gulf-clean engine

The *New* A-MP "24-20" Terminal and Connectors are designed expressly to resist *vibration, shock and similar stresses* encountered in wire applications in every industry. They retain all of the excellent features of the A-MP Pre-Insulated Diamond Grip line, with special emphasis on the need for weight and space savings so important in today's equipment design.

Features of the *New* A-MP "24-20" Terminal and Connector are:

• Designed to accommodate smaller insulation diameters of new wire specifications. • Nylon insulated for the many favorable advantages provided by this reliable synthetic material. • Miniaturized for space and weight savings. • The unique design of the terminal's tongue area affords maximum utilization of the metal's inherent structural characteristics.



The new yellow and white color-coded A-MP "T"-Head Hand Tool provides wide range, light weight application tooling for the *New* A-MP "24-20" Terminal and Connector. An A-MP Double-Action Hand Tool is available, also. Both tools feature the A-MP Certi-Crimp® Control . . . for positive crimping of the terminal to the wire.

Additional information is available on request.

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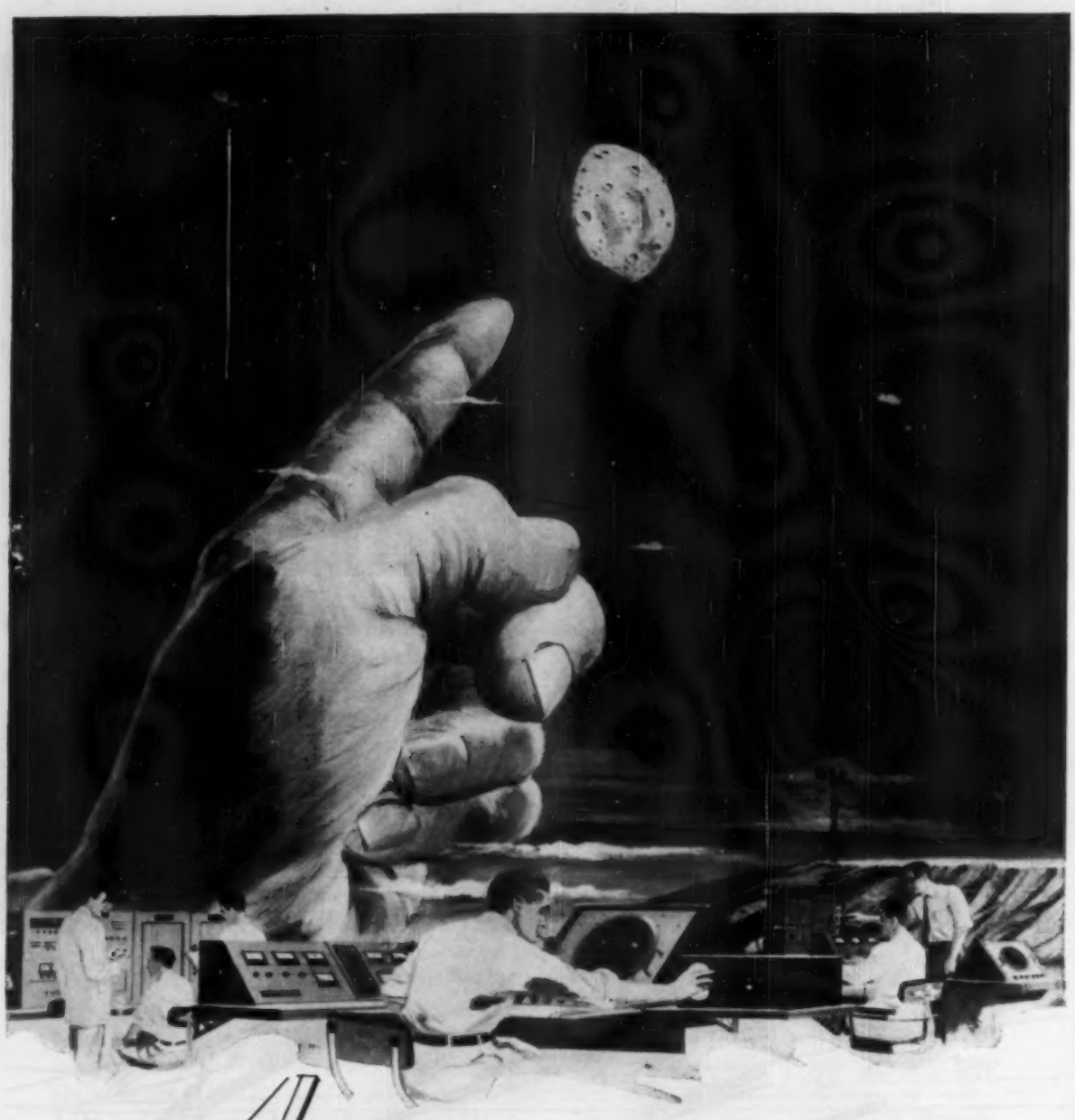
AMP—Holland N.V.'s-Hertogenbosch, Holland

Distributor in Japan: Oriental Terminal Products Co., Ltd., Tokyo, Japan



An advanced concept

The Singer Manufacturing Company announces the formation of its Military Products Division, which through its three functional units, Haller, Raymond & Brown, Inc., Diehl Manufacturing Company, and Singer Bridgeport Division, can efficiently handle complex electro-mechanical and electronic programs from concept to completion.

SINGER *

THE SINGER MANUFACTURING COMPANY

Military Products Division

149 BROADWAY, NEW YORK 6, N. Y.

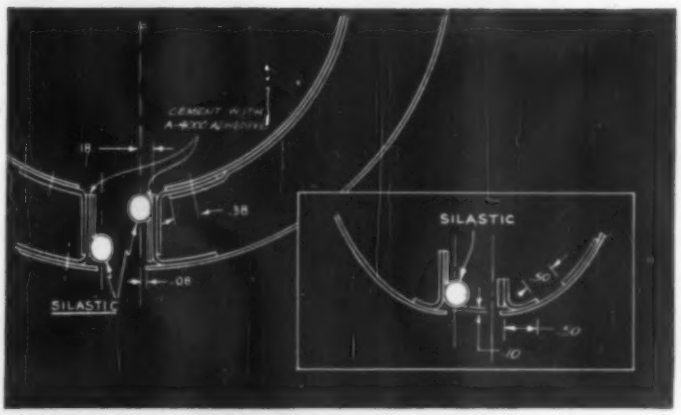
*A TRADEMARK OF THE SINGER MANUFACTURING COMPANY

The PLANE

Republic's F84F Thunderstreak, in operation for the USAF and several NATO nations. The swept-wing single-seat fighter is powered by a Wright J65 turbojet to speeds upwards of 650 m.p.h.; carries drag parachute for short landings.

The PROBLEM

To find an effective seal for the drag chute door. Located far aft, this seal is subjected to both heat from the jet engine and severely cold slipstream. A seal with reliable rubberiness at both temperature extremes was needed.



The PART

....SILASTIC

SILICONE RUBBER

Republic ordered seals of Silastic®, the Dow Corning silicone rubber. Silastic stays rubbery, forms reliable closure.

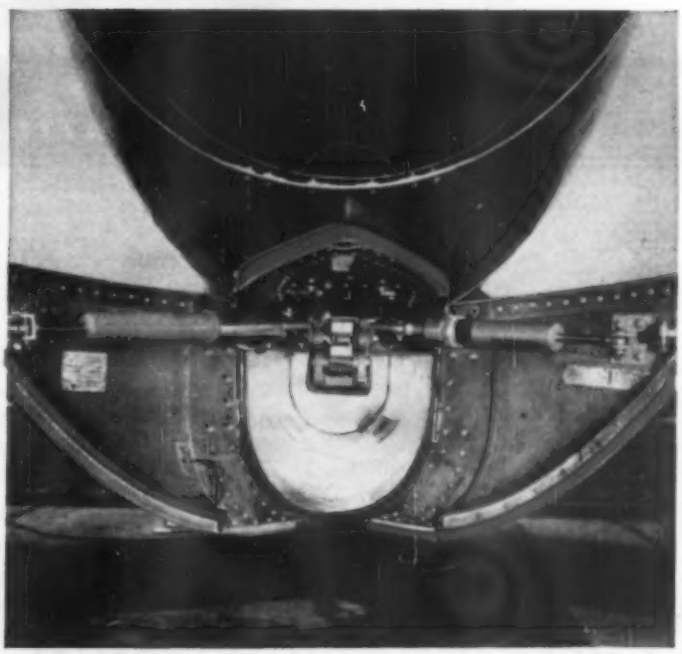
TYPICAL PROPERTIES OF SILASTIC FOR SEALS

Temperature range, °F	—130 to 500
Tensile strength, psi	750 to 1400
Tear strength, lb/in	100 to 200
Compression set, %, @ 300 F	20 to 40

For details, write Dept. 099.

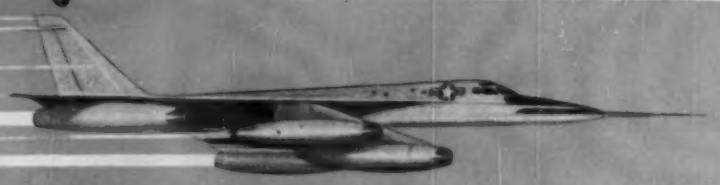
first in silicones

Dow Corning
CORPORATION
MIDLAND, MICHIGAN



Beltrol

There is nothing like it in pressure switching



DESIGNED TO AIRCRAFT SPECIFICATIONS

AND PRICED FOR COMMERCIAL APPLICATIONS

BUILT TO MISSILE SPECIFICATIONS

Pressure Range Setting 0 to 500 PSIG
Current Rating 10 amps ind. at 28 VDC
10 amps 115 VAC
Tested to MIL Spec. MIL-E-5272A and vibration to 50 G's
10 to 2000 cps.

Weight 7 ounces
Cubic Volume 6 cubic inches
Stability —65° to 325° F tolerance of plus or minus 5%

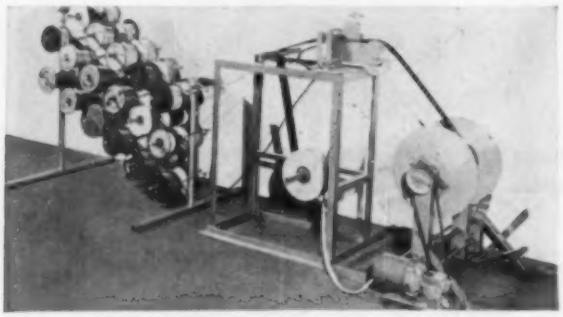
by DIAFLEX

A DIVISION OF COOK ELECTRIC COMPANY • CHICAGO 14, ILLINOIS

NEW Automatic Electronic Cable-making Machine Announced

(Los Angeles, California) After years of development, The Zippertubing Company announces production of a machine which automatically makes cables at speeds up to 900 feet per hour. This machine, occupying only 24 square feet of floor space, produces cables with up to 108 conductors and is so simple to operate that inexperienced personnel can make cables to any specification.

This new equipment utilizes the revolutionary Zippertubing cable jacketing, which is fed into the machine along with the required number of conductors. The Zippertubing then is automatically wrapped around the conductors, zipped closed and, if required, permanently fused with a chemical sealer. The completed cable automatically is wound on the take-up reel for storage or shipping. The machine will produce cable from ⅜" to 2½" O. D. with larger sizes on special order.



Complete unit with wire reels in place.

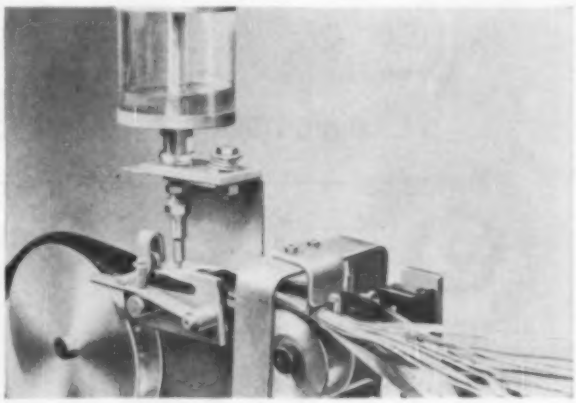
MULTI-JACKETED CABLES IN ONE STEP

By using Zippertubing laminated materials, cables which require jackets of several different materials can be made in one step without costly re-handling. Available jackets include copper, aluminum or Co-netic steel in combination with such materials as vinyl, Mylar,* or fiber glass. Other laminates for high temperature exposure, abrasion protection, etc., also may be used in the machine.

SUBSTANTIAL SAVINGS

Up to 90% of the labor costs formerly involved in fabricating cables are eliminated through the use of the Zippertubing Cable Machine. Only limited floor space is necessary for long-run continuous lengths, and material waste, skilled labor investment and expensive extruding equipment no longer are required. Expensive "minimum" orders for custom extruded cabling as well as delay in deliveries also are eliminated. Because of the flexibility of Zippertubing, small cable runs for R & D work are economically feasible. Zippertubing cables can be re-opened for additional work on conductors, virtually eliminating the great costs formerly incurred in correcting mistakes in prototype development.

**Trademark of duPont.*



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For complete catalog information or field engineering service, write to the manufacturer: The Zippertubing Company, 752 So. San Pedro St., Los Angeles 14, California. TWX LA 840. Sales offices and warehouses are located in all principal cities.

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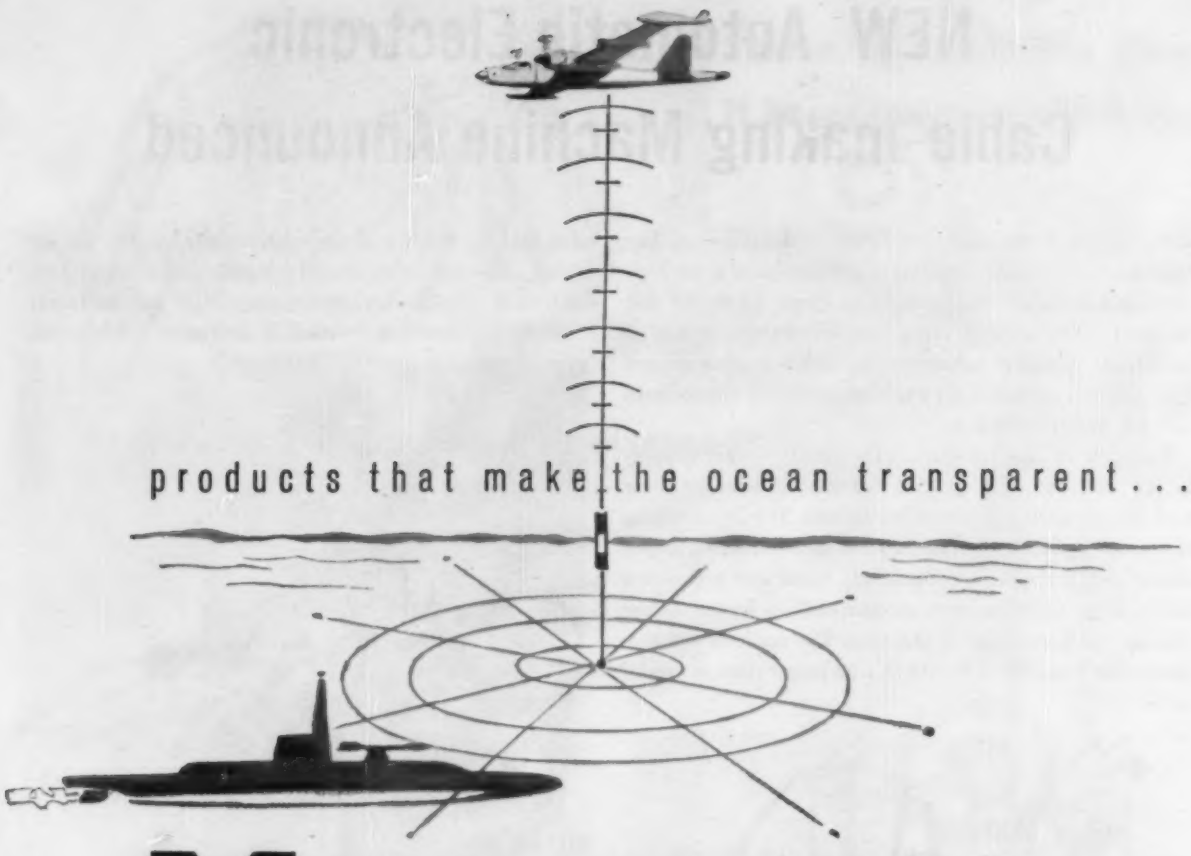

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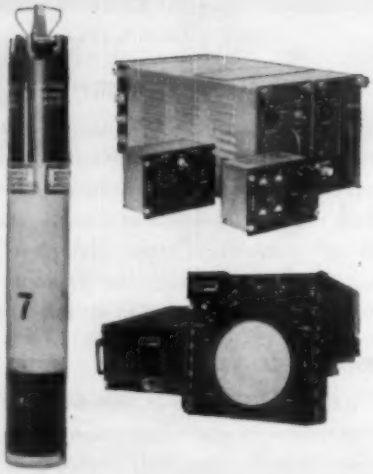

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September 15, 1958

Aviation Week

Including Space Technology

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COVER: These British helicopters built by Westland Aircraft Ltd. are based on Sikorsky designs for which Westland has a license. Helicopters, left to right, are: Westland Westminster gas-turbine-powered flying crane, based on the S-56; Westland Wessex anti-submarine helicopter of the Royal Navy, powered by a Napier Gazelle gas turbine and based on the S-58; Westland Whirlwind Royal Navy ASW helicopter equipped with homing torpedoes and powered by Alvis Leonides Major piston engine—based on the S-55; and Westland Widgeon five-passenger utility helicopter, based on the S-51.

PICTURE CREDITS

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74,002 copies of this issue printed

white areas show extensive use of magnesium

MAGNESIUM ALLOYS BUILD BIGGER PAYLOADS INTO SIKORSKY 'COPTERS

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For more information about magnesium, contact your nearest Dow Sales Office or write THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA1402-K-3.

MAGNESIUM FORM	LBS. USED		
	S-55	*S-58*	*S-56*
Sheet	580	1303	2288
Extrusions	68	51	246
Castings	307	266	1466
Forgings	77	198	1144
Bar and Tube	83	186	414
Total	1,115	2,004	5,558

YOU CAN DEPEND ON DOW

EDITORIAL

Stoned in Athens

In the twilight of Greece's glory it became the custom for the soft and flabby citizens of Athens to stone messengers who disturbed their pleasure and complacency by bringing them news of impending danger. Events of the past few months may lead many thoughtful citizens of this land to wonder whether we are not nearing the same sort of philosophy.

There is little doubt that the news of our military and scientific progress in relation to that of the Soviet Union has been almost uniformly bad during the past year. Warnings have been sounded by the most substantial types of citizens and scientists most intimately concerned with these matters. The reports of the Gaither Committee and the Rockefeller group sounded clear warnings based on careful study. The Senate Preparedness Subcommittee headed by Senator Lyndon Johnson of Texas unanimously endorsed a bipartisan report sounding a warning klaxon and detailing specific courses of remedial action.

Only a few weeks ago a group of distinguished scientists added a new note of warning with a detailed analysis of the growth of the threat of Soviet submarines equipped with guided missiles of cruise and ballistic varieties. Faced with this overwhelming evidence that the hour of military urgency is upon us, several senators took to the floor in the closing days of the Congressional session to plead again for decisive, courageous action to avoid the dangerous disparity in military strength between the United States and the Soviet Union that now looms for the early 1960s. Reaction to these thrice repeated warnings suggests that our governmental leaders may be on the verge of the mental attitudes that led the citizens of Athens to stone messengers bearing dire tidings and to go stupidly to their doom.

Here are some of the symptoms of this ostrich head in the sand attitude that have appeared publicly in recent weeks. First, Senator Leverett Saltonstall who has been the Republican spokesman on defense matters in the Senate took the floor to reassure the people that all was indeed well with defense progress. Senator Saltonstall's reputation for being well informed on defense matters is not strong. We still recall his fatuous statement that this nation's military strength was based on its growing stockpile of ballistic missiles when one had yet to be test fired from Cape Canaveral. Even today, several years after Senator Saltonstall's statement, we do not have a single operational ballistic missile in either intermediate or intercontinental range. So much for Senator Saltonstall's credentials as a reliable witness of defense matters.

Next we see the spectacle of a national weekly magazine whose reporting in recent years has been heavily tinged with glossing over the hard facts of our defense situation propounding the theory that a new disease called the "Sputnik Syndrome" is afflicting part of the American people. According to this theory, anybody who is worried about the Soviet progress in supersonic aircraft, ballistic missiles and space exploration is simply the victim of a fever which causes Sputniks to be seen before the eyes. This magazine attempts to dismiss the rising tide of serious and informed criticisms of our defense situation with a honeyed presentation of Senator Saltonstall's Pentagon-prepared whitewash, implying strongly that this is the real state of affairs and the critics are simply frightened men who see Sputniks under the bed.

The facts cited by Senator Saltonstall as evidence of United States progress are more accurate than his usual statements on defense matters, but they completely ignore the comparative status of the United States and the Soviet Union. They completely and deliberately neglect the critical question of relative rates of progress in this vital technological race. For perspective on Senator Saltonstall's attempt to lull this country into a false sense of security and on the efforts of some magazines to dismiss informed critics of the defense situation as feverish victims of the "Sputnik Syndrome" we would like to cite the rebuttal of Senator Stuart Symington of Missouri whose authority and interest in defense matters is second to none in Congress.

"If in the debate," he said, "anyone was attempting to tell the people this country is ahead in medium range ballistic missiles, that is not correct. The Russians are well ahead of us. If the implication was that this country is ahead in long range ballistic missiles, this is also incorrect. In this latter field the Russians are at least two years ahead of the United States. If there is any implication that this nation is not seriously deficient in airlift for both its ground armies—the Army as well as the Marines—that is incorrect. A figure of 130 ICBMs was referred to by one senator and the assertion made that the United States had programs for producing more than 130 ICBMs by 1962. That is not correct and it is very dangerous to our national security to assert that it is correct. If the implication was that the missile program is now being run on a crash basis . . . that is not correct. If the implication was that we will soon have even one Polaris submarine, that is not correct. . . . The statement that the Russians are only a few months ahead of us in the ICBM field is not correct. The implication that under present programs the Soviets are not increasing their lead in the ICBM field is incorrect."

We have already gotten long past the time when the state of our defense progress was a fit subject for political debate. We are long past the time when our leaders should have candidly outlined the hard facts and detailed the strenuous effort that is required to again reassert our unchallenged leadership in this vital area. For the real tragedy is not that this country lacks the capacity to get out in front and stay there indefinitely but that it is being held back and not permitted to progress at the rate that our ability will permit. It is very late but not yet too late for the leaders of this country to speak candidly and completely on the bitter facts facing us in the early 1960s. It is late but not too late to stimulate the country to the effort that is required to regain a position of military and scientific leadership on which any international political leadership must of necessity be based.

—Robert Hotz

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Charles D. Manhart, vice president-government relations, Raytheon Manufacturing Co., Waltham, Mass.

George S. Vermilyea, executive vice president, and **Ralph E. Grimm**, director of engineering, Nems-Clarke Co., Silver Spring, Md.

J. P. Lawler, a vice president, Aeronca Manufacturing Corp., Middletown, Ohio. Mr. Lawler continues as Washington, D. C., representative.

Oliver G. Haywood, Jr., vice president, F. C. Huyck & Sons, New York, N. Y.

Dr. C. J. Breitwieser, vice president-engineering and sales, Air Logistics Corp., Pasadena, Calif. Dr. Breitwieser will also serve as president of Metrolog Corp., a new subsidiary of Air Logistics.

McLean B. Smith, vice president and general manager, Data Processing Division, International Business Machines Corp., New York, N. Y. Also: **Gilbert E. Jones**, assistant general manager.

Maj. Gen. Arthur W. Vanaman (USAF, ret.), assistant to the president, Aerojet-General Corp., Azusa, Calif.

Changes

Robert W. Fausel, corporate West Coast representative (Los Angeles, Calif.), The Martin Co., Baltimore, Md.

Dr. Henry S. Odbert, Program Director of Psychobiology, National Science Foundation, Washington, D. C.

Rear Adm. John A. Scott (USN, ret.), coordinator—military requirements, Link Aviation, Inc., Binghamton, N. Y.

Hugh E. Webber, manager-ground systems, The Martin Co.'s guided missile and electronics center, Orlando, Fla.

Capt. Jack Shoenhair (USN, ret.), assistant weapon systems manager-Polaris, Lockheed Missile Systems Division, Sunnyvale, Calif.

The Boeing Airplane Co., Seattle, Wash., has appointed the following assistant general managers for the Pilotless Aircraft Division: **Kenneth W. Brown**—operations; **Jack Strickler**—administration. **Richard H. Nelson** succeeds Mr. Brown as manufacturing manager.

Beverly H. Gallup, resident engineering representative at Griffiss AFB, Rome, N. Y., for Motorola's Military Electronics Division.

Frederick B. Cline, program director—Air Weather Reconnaissance Development Program, Bendix System Division, Ann Arbor.

Stuart D. Davies, chief engineer for a new project, Hawker Siddeley Group, London.

Donald J. Murphy, assistant weapon system manager—Air Force's earth satellite program, Lockheed Missile Systems Division, Sunnyvale, Calif. Also: **Robert M. Salter**, assistant for future applications.

(*Continued on p. 123*)

INDUSTRY OBSERVER

► Boeing Airplane Co. and Northrop Aircraft Corp. are submitting proposals to Air Research and Development Command for solid-propellant-powered air-to-surface missile with increased speed and range application to Convair's B-58 supersonic bomber and North American Aviation's B-70 Mach 3 intercontinental bomber. Lockheed Aircraft Corp. previously had submitted a proposal for use of a modified X-17 solid propellant nose cone test vehicle as an air-to-surface missile for the B-58.

► Special committee headed by Professor John Wheeler of Princeton University is advising Secretary Neil H. McElroy on research and development management organization in the Defense Department. Biggest problem facing the committee is to recommend the exact relationship and division of responsibility that will exist under the still unnamed Director of Defense Research and Engineering. The Advanced Research Projects Agency under Roy Johnson, Director of Guided Missiles William M. Holaday and Assistant Secretary of Defense (Research and Engineering) Paul D. Foote will all report to the new director.

► One of main objectives in Soviet Air Force tactical training since early 1957 has been to improve their operations against electronic countermeasures. A large percentage of bomber training flights have involved searching for targets in bad weather and at night under intense radar interference.

► Tight Defense Department fiscal policy may force Navy to abandon its Eagle long-range air-to-air missile now in the early phases of development in favor of the Hughes GAR-9 being developed for the Air Force for use on the North American F-108 Mach 3 fighter. Both missiles have similar capabilities and both would be equipped with nuclear warheads, but GAR-9 is further along the development path.

► Organometallic compounds—organic structures incorporating metals such as boron and phosphorous—could prove to be the "exotic" lubricants of the future. Applications would be in real high-speed aircraft or spacecraft systems where specifications are expected to call for lubricants capable of operating at 1,000F and above. Air Force already has let contracts to chemical and petroleum companies for research on these and other potential high-temperature lubricants.

► Swing-tail aft loading entrances being proposed for military cargo versions of the Boeing 707 and Douglas DC-8 jet transports involve breaking the fuselage in the pressurized area and swinging the entire tail section upward or to the side. Boeing would swing the tail upward while Douglas favors the sideward opening approach. Air Force has not decided whether the weight penalty the entrances would involve is acceptable. Companies also have proposed 17-ft.-wide side entry cargo doors.

► Australians are quietly shopping in the U. S. for a supersonic bomber or fighter bomber to replace present fleet of English Electra Canberras. Royal Australian Air Force planners want the combat radius of the aircraft to be at least 1,500 mi. One aircraft under serious consideration is Republic's F-105 fighter-bomber.

► Canadair CL-28 is being offered to the RAAF in an effort to market some of the Canadian industry's output in that country, although at present the Australians have no plans to replace the Lockheed P2Vs now being used for maritime reconnaissance. Canadians also are offering Australia the right to manufacture under license Canadair's new jet basic trainer, the CL-41.

► Russian troubles with disseminating technical information both foreign and domestic apparently are the exact opposite of those of the U. S. in this area. Recent editorials in Soviet technical journals complain of too many institutes devoting too much time to translation and publication work and contend that the entire effort is uncoordinated.

► General Electric CJ-805-3, commercial version of the J79 turbojet, received Civil Aeronautics Administration certification last week for civil use.

Barden Precision SFRI-5 miniature bearings as used in a computer gear train.

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Washington Roundup

Boeing Top Contractor

General Motors has been replaced by Boeing Airplane Company as the top holder of military contracts with a total of $7.7 billion. General Motors holds contracts worth about $4 million less. The Pentagon also reported that 100 companies and their affiliates received 63.5% of all military prime contracts during the last seven and a half years. The top contract winning company for the one-year period ending last Dec. 31 was General Dynamics Corp., which received $1,127,400,000 in new business. General Electric Co., United Aircraft Corp., and Boeing followed in that order in the new business category.

McElroy Slaps Wrists

Secretary Neil McElroy last week moved to stop the growing dispute over the relative merits of the Air Force's Bomarc and Army's Nike Hercules air defense missiles. The dispute began when Congress complained of missile duplication for air defense and cut about 20% from the combined Army-Air Force request for Nike Hercules and Bomarc bases in an apparent effort to make the Department of Defense choose between the two missiles (AW Aug. 11, p. 21).

The appropriations cut led to a series of public claims by the two services on the advantages of their respective missile systems and culminated in a complaint forwarded to top Army echelons by Lt. Gen. Charles E. Hart, commander of the Army's Air Defense Command. Gen. Hart charged that the Air Force was attempting to downgrade the Hercules. The Air Force replied that it had similar information about derogatory Army references to Bomarc.

McElroy said last week that he has "passed the word that this should be stopped." He declined, however, to indicate whether one of the missiles would be discarded or which bases would be eliminated as a result of the cut in funds or when these decisions would be made.

He did say that he believed a defense in depth is the best defense against aerial attack, presumably meaning that both missiles have their place.

Wilsonisms From Russia

Soviet scientists apparently have not been any more successful than their U.S. counterparts in creating a nationwide understanding of the value of basic research. Recent papers by Communist theorists in Russia complain that basic research scientists do not have work norms like other workers. The theorists point out that scientists and engineers on development projects have final goals and specifications to work towards which can be used to gage performance but that basic scientists are completely beyond any sort of regulation and that no measure can be taken of their contribution to the Soviet society.

This approach is reminiscent of the blunt remarks by Charles Wilson and some of the U.S. government's actions. One of Wilson's definitions was that you could tell when a project was basic research because the scientists "can't tell you what they're doing." One of the Administration's post-Sputnik actions was to cut the budget request of the National Science Foundation which is charged with the promotion of basic research in the U.S. The foundation's request for $222 million, primarily for grants for basic research in 1959, was cut to $140 million by the White House.

White House Surprised

Long period of hedging by top-level White House staff members over releasing the economic analysis of the airline industry prepared by Dr. Paul Cherington of Harvard University is considered by most observers as another case of Administration jitters over releasing news that might not be good news. The White House group sat on the Cherington report for two months—despite the eagerness of Presidential Assistant Elwood Quesada to release it—before giving it to the public and accepting the criticism that they expected would follow. To their surprise, the report evoked—not criticism—but praise. The Cherington report has been given wide circulation by the airline industry itself and is expected to serve as a key to many of the problems the industry faces with the introduction of jet equipment.

NASA Policy Council

James H. Doolittle was one of four prominent aviation and science experts appointed by President Eisenhower last week to the National Aeronautics and Space Council. Also named to the nine member council, Policy Board for the National Aeronautics and Space Administration with the President as chairman, were William A. M. Burden, special assistant for research and development to the Secretary of the Air Force in 1950-52; Dr. Alan T. Waterman, director of the National Science Foundation, and Dr. Detlev Bronk, president of the National Academy of Sciences since 1950 and president of Rockefeller Institute of Medical Research since 1953.

President Approves Air Museum

A National Air Museum in Washington to replace the sheetmetal hut now housing the Smithsonian Institute's collection of aeronautical equipment came closer to reality last week when President Eisenhower signed a bill authorizing plans for the museum to be built. Once plans and specifications have been drafted by the General Services Administration, group must return to Congress for funds to cover the cost of construction.

Local Carrier Concern

Local service carriers are upset by the Civil Aeronautics Board announcement that it intends to apply the much disliked 9.5% rate of return formula to final mail rates being considered for Mohawk Airlines (AW Sept. 8, p. 44).

In that case, the Board said it would apply the formula, offered by the Bureau of Air Operations in the Local Service Carriers-Rate of Return Investigation, to all carriers receiving final mail rates, pending a final decision in the case. Carriers feel the Mohawk rate may amount to a prejudging of the full rate case, in which they seek a rate of approximately 12% on different formulas.

The carriers' fears apparently are shared by CAB member G. Joseph Minetti who criticized the action of his colleagues in the Mohawk case. In a dissenting opinion on the rate, Minetti said the bureau counsel's advocacy of the 9.5% figure in the Local Service Case was not equivalent to Board resolution of the issue.

—Washington staff

Defense FY '59 Funds Total $41 Billion

Expenditures increased $1.8 billion above Fiscal '58; obligational authority estimates hit $41 billion.

By Ford Eastman

Washington—Expenditures available for Defense Department military programs during Fiscal 1959 will be $1.8 billion above actual expenditures during Fiscal 1958 and $521 million more than that estimated by the Administration in January.

New obligational authority estimates for military programs have been increased to $41.078 billion from the $39.645 billion estimate in January—an increase of $4.329 billion over actual 1958 obligations.

Current expenditure estimates are now $40.8 billion as compared with the January estimate of $40.279 billion and the 1958 actual expenditures of $39.010 billion.

The expenditure estimate released by the Administration last week includes the $816 million additional made available by Congress in excess of the amount requested for missiles, aircraft and manpower.

Administration's Stand

However, Administration spokesmen have taken a strong stand against spending more money than that originally requested and may withhold these funds from the services.

At the same time, both industry and Defense Department officials say they do not anticipate the rigid ceilings on defense spending that created a financial chaos toward the end of Fiscal 1958 (AW April 21, p. 26), although the situation, they admit, is still "somewhat cloudy."

Defense Department reorganization authorized by Congress and the increase in the debt ceiling is expected to give the Administration considerable latitude in setting fiscal policies during the coming year.

Budget Breakdown

Defense Department breakdown on estimates of net expenditures for major procurement and production amounts to the following:

- **Aircraft**—Air Force, $5.093 billion; Navy, $1.959 billion; Army, $118.778 million; total, $7.171 billion.
- **Missiles**—Air Force, $2.298 billion; Navy, $481.327 million; Army $593.270 million, total, $3.372 billion.
- **Electronics and communications**—Air Force, $352.5 million; Navy, $189.152 million; Army, $197.925 million; total, $739.577 million.

Gross obligations estimates break down this way:

- **Aircraft**—Air Force, $4.993 billion; Navy, $1.954 billion; Army, $136.007 million; total, $7.083 billion.
- **Missiles**—Air Force, $2.805 billion; Navy, $785.191 million; Army, $998,271 million; total figure of $4.588 billion.
- **Electronics and communications**—Air Force, $823.7 million; Navy, $288.007 million; Army, $250,195 million; total figure amounts to $1.361 billion. Major changes in Defense Department expenditures made by the Administration in its mid-year review of the Fiscal 1959 federal budget are the following:
- **Military personnel costs** increased from $10.523 billion to $10.570 billion. In Fiscal 1958, actual expenditures amounted to $10.439 billion.
- **Operation and maintenance**, including equipment, facilities, medical care, supply systems and purchase of spare parts, increased from $9.292 billion to $9.419 billion. The 1958 actual was $9.072 billion.
- **Major procurement and production** of aircraft, ships, vehicles, weapons, missiles and other items increased from $13.753 billion to $14.278 billion. This represents a decrease of $389 million from the $14.667 billion actual expenditures in Fiscal 1958.
- **Military construction**, reserve components, research and development and others increased from $6.007 billion to $6.363 billion. The 1958 expenditures were $4.832 billion.
- **Defense contingency funds** were reduced from $500 million to zero. This allowance is now distributed among the several other categories in which defense expenditures are classified, accounting for some of the increases in current estimates when compared with the January estimate.
- **Anticipated supplemental funds** were reduced from $205 million in January to the currently arrived at estimate of $180 million.

Major changes in new obligational

Estimated Net Expenditures—Fiscal 1959

(in thousands)

	Army	Navy	Air Force	Office of Secretary of Defense	Total
I. Military Personnel Costs	$3,501,496	$3,146,009	$3,922,000	$.....	$10,569,505
II. Operation and Maintenance	2,773,998	2,563,119	4,214,999	.....	9,552,116
III. Major Procurment and Production	1,312,948	4,400,698	8,577,030	2,500	14,293,176
Aircraft	118,778	1,959,820	5,093,000	.....	7,171,598
Missiles	593,270	481,327	2,298,000	.....	3,372,597
Ships	2,390	1,396,633	200,000	2,500	1,601,523
Other	598,510	562,918	986,030	.....	2,147,458
IV. Military Construction	330,000	401,460	1,205,000	40,670	1,977,130
V. Reserve Components	706,200	226,380	306,500	.....	1,239,080
Reserve Construction	.....	.....	.....	.....	.....
Other	.....	.....	.....	.....	.....
VI. Research and Development	516,600	717,181	765,000	410,624	2,409,405
VII. DOD Establishment-Wide Activities	296,632	32,625	16,410	716,866	1,062,533
Retired Pay	.....	.....	.....	.....	.....
Other	.....	.....	.....	.....	.....
VIII. Working Capital (Revolving) Funds	—275,078	—15,450	18,400	42,000	—230,128
Total—Net Expenditures	9,162,796	11,472,022	19,025,339	1,212,660	40,872,817

New Obligational Authority Fiscal 1959

(in thousands)

	Army	Navy	Air Force	Office of Secretary of Defense	Total
I. Military Personnel Costs	$3,550,961	$3,181,412	$923,073	$.....	$10,655,446
II. Operation & Maintenance	2,746,363	2,465,408	4,051,420	.....	9,263,191
III. Major Procurement & Production	1,650,633	4,822,400	8,863,495	.....	15,336,528
Aircraft	130,392	1,680,487	4,534,595	.....	6,345,474
Missiles	629,416	735,244	2,972,400	.....	4,337,060
Ships	.....	1,977,155	.....	.....	1,977,155
Other	890,825	429,514	1,356,500	.....	2,676,839
IV. Military Construction	230,000	295,000	785,000	20,000	1,330,000
V. Reserve Components	652,462	215,097	303,681	.....	1,171,240
Reserve Construction	6,250	8,000	12,000	.....	26,250
Other	646,212	207,097	291,681	.....	1,144,990
VI. Research and Development	498,700	821,285	743,000	670,000	2,732,985
VII. DOD Establishment–Wide Activities	274,990	30,625	2,555	702,917	1,011,087
Retired Pay	.....	.....	.....	640,000	640,000
Other	274,990	30,625	2,555	62,917	371,087
VIII. Working Capital (Revolving) Funds	.....	.....	.....	50,000	50,000
Total–New Obligational Availability	9,604,109	11,831,227	18,672,224	1,442,917	41,550,477
Transfers from Prior Year Balances	375,000	160,000	.....	.....	535,000
Total–New Obligational Authority	9,229,109	11,671,227	18,672,224	1,442,917	41,015,477

authority estimates, which reflect both presidential amendments to the January recommendations and increases enacted by Congress over the recommended amounts, include:

- **Military personnel costs reduced** from $10.225 billion to $10.120 billion. The 1958 obligations amounted to $9.816 billion.
- **Operation and maintenance reduced** from $9.322 billion to $9.263 billion, a decrease of $108 million from Fiscal 1958.
- **Major procurement and production** increased from $13.447 billion to $15.297 billion. The 1958 obligations amounted to $11.399 billion.
- **Military construction,** reserve components, research and development and others increased from $5.946 billion to $6.218 billion. The 1958 obligations were $6.163 billion. For a more detailed breakdown, see the tables prepared by the Defense Department on estimated new obligational authority and estimated expenditures.

Budget Defense

Defense Secretary Neil McElroy, in a speech at an American Legion Convention in Chicago, defended the Fiscal 1959 budget as a sound program to keep the U. S. ahead of Russia in over-all military strength.

He indicated, however, that Defense will continue to hold a relatively tight rein on research and development spending.

"Defense spending," he said, "will be guided with discrimination and judgment. We are willing to take greater gambles on weapons that no business enterprises would vote to risk on new and still untried products.

"There is a point, however, beyond which gambling huge sums on untried weapons would be foolhardy and would, in fact, endanger the economic, and even the military, security of the country."

McElroy added that, as research and development programs progress, added production will be worthwhile, but that, in the meantime, the U. S. cannot move production too far ahead of research knowledge.

Polaris Project

One of the programs increased by Congress whose funds have not yet been released by the Defense Department is the Navy's Polaris ballistic missile submarine project.

Congress authorized construction of four additional Polaris submarines, but the Defense Department contends that the five already authorized should proceed further along the development cycle before work on the additional four is begun.

Projects authorized by the Defense Department and announced by the Navy, however, include the construction of seven guided missile frigates, including three remaining from the Fiscal 1958 program; three nuclear-powered attack submarines; five guided-missile destroyers.

Authorized Funds

Other funds authorized by Congress which might be withheld include $140 million for additional long-range transport aircraft for Army airlift and $51.6 million for 15 additional Boeing KC-135 jet tankers.

Of the total Fiscal 1959 funds available, Air Force requirements from industry will be about $10 billion, Brig. W. A. Davis, Air Materiel Command weapon system deputy director, said last week.

Davis said about $6 billion of this will go for new weapons and equipment and $4 billion for hardware to support the operating Air Force. The two, he said, will involve 4,000 prime contractor facilities and a much larger number of subcontractors.

Marquardt to Acquire AMF Subsidiary

Marquardt Aircraft Co. has started final negotiations with American Machinery & Foundry Co. (AW July 28, p. 25) to purchase for an undisclosed amount of cash AMF's Associated Missile Products Co., Pomona, Calif.

Boards of directors of both Marquardt and AMF have already approved the acquisition and Marquardt is aiming for an effective acquisition date of Sept. 28. After final negotiations, terms will be submitted to both companies' boards of directors for final approval.

Marquardt will retain AMPCO's key personnel including Dr. Wendell B. Sell, present vice president of AMF and general manager of AMPCO. He will remain general manager of AMPCO when it becomes a new division of Marquardt. No name for the new division has been selected, but a Marquardt spokesman says it will definitely not be AMPCO.

No obstacles to Marquardt's acquisition of AMPCO are anticipated.

Congress Expected to Override Airport Aid Veto Early Next Year

By Katherine Johnsen

Washington—Aviation circles expect Congress to take early action next year and pass legislation authorizing a large-scale airport development program—and override a presidential veto, if necessary.

Reaction to President Eisenhower's veto of the airport development measure (AW Sept. 8, p. 41) overwhelmingly voted by the Congress was strong. The legislation would have authorized up to 50% federal participation in the construction cost of airports for four more years.

The present authorization expires with the current Fiscal 1959 year. It also would have increased the total federal outlay from $63 million to $100 million annually.

Sen. Mike Monroney (D.-Okla.), chairman of the Senate Commerce Aviation Subcommittee and one of the leading advocates of the legislation called the veto "a body blow to air safety."

"Not only does his action endanger a safe transition to the jet air age, but it also jeopardizes the investment of more than $2 billion in these advanced types of airplanes already on order by commercial airlines," Monroney declared. "Without the federal-local partnership in sharing the cost, he added, "commercial jet transportation will be limited to the use of seven civilian airports of sufficient size to handle takeoffs and landings under full load.

"Even these seven (New York International, Boston, Baltimore, Detroit, San Francisco, Portland, San Diego), with 10,000 ft. runways, would need a second runway to handle safe takeoffs for crosswind conditions. . . .

"It will be of little use to provide for safer airspace and air traffic regulations if the planes must land on fields too short or too poorly constructed to handle them on the ground."

Figures of Civil Aeronautics Administration show that the backlog of needed airports—with local sponsors ready with 50% financing—has been steadily mounting. With $63 million annually to allocate, CAA has had requests for matching funds from would-be sponsors as follows:

Fiscal 1957, $131 million; Fiscal 1958, $145 million; Fiscal 1959, $192 million.

The total in matching fund requests for the three years of $469 million was approximately two-and-one-half times more than the $189 million Civil Aeronautics Administration had allocated.

A survey by the U. S. Conference of Mayors shows that 1,138 airports projects costing a total $1.1 billion will be required over the next four years—Fiscal 1959 through Fiscal 1962. Of the total, local and state sources expect to be able to finance $590 million. This leaves a deficit of $471 million which the Conference says should receive federal financing "because of the vital national interest in the airports. . . ."

Confused Thinking

E. Thomas Burnard, executive director of Airport Operators Council, criticized the "confusion and inconsistency in Administration thinking—as well as the continuing lack of appreciation of the national interest in airports."

In May, 1957, Edward P. Curtis, then presidential adviser on civil aviation, urged a comprehensive airport program.

In his comprehensive report, which outlined plans for the Airways Modernization Board and Federal Aviation Agency, Curtis said:

"Of all the elements in the national system of aviation facilities, airports have been the most neglected. Unless airport development is given the attention it deserves, airport capacity may well become the factor which limits capacity in the whole system."

However, Louis Rothschild, Under Secretary of Commerce for Transportation, testifying for the Administration last April before the Senate Commerce Committee, called for an end to all federal airport aid. When the present authorization expires with Fiscal 1959, Rothschild maintained, state and local sources should fully finance airport projects.

President Eisenhower altered the Administration position as presented by Rothschild in his veto message. The President called for "an orderly withdrawal" of the federal government from airport aid, and announced that he would submit a plan for a "transitional" program to the next Congress. He added:

"I recognize that there will doubtless be a transitional period during which the federal government will be required to provide aid to urgent airport projects which are essential to an adequate national aviation facilities system and which cannot be completed in any other way."

The $100 million-a-year program provided in the legislation voted by the Congress, the President objected, "does not provide for a transitional program. Rather, it sharply increases the level of the existing program.

"It does not provide for aid to the most urgent airport projects, but continues the current allocation formula which is not related to broad national aeronautical needs."

Meanwhile, CAA Administrator James T. Pyle and the future traffic estimates of CAA emphasized the increasing requirement for airport development.

In a speech to the annual meeting of the U. S. Conference of Mayors last week in Miami, Pyle declared:

"I can visualize the day when your terminals will be swamped with bus-type transportation, and I feel it my obligation to you to warn you of this potential development so that you can inject it into your planning. We are already doing so at the Washington National Airport and will present to Congress next year a plan which we feel will materially increase the capacity of this facility to handle the mass transportation I foresee for the future."

These are CAA traffic estimates (by calendar years):

- **Domestic passengers.** The number will increase from 42 million for 1956 to between 60 million and 72 million in 1960; and to between 80 and 106 million in 1965.
- **Domestic cargo.** The ton-mileage will mount from 380 million for 1956 to between 500 million and 700 million in 1960; and to between 800 million and 1.2 billion in 1965.
- **International and overseas passengers.** The number will rise from four million in 1956 to between 4.8 million and 6.8 million in 1960; and to between 6.1 million and 11.5 million in 1965.
- **General aviation** (all civil aircraft flying exclusive of air carrier operations). The number of hours of flight utilization will mount from 9.5 million for 1955 to 11.8 million for 1960 and to 15.3 million for 1965.

Specific points in the presidential veto message which Burnard of the Airport Operators Council objected to included:

- That "over the past two decades, more

F-104 Has Infrared Eye

Washington—Air Force Lockheed F-104 Starfighter is being equipped with an infrared gunsight that enables it to track down targets its pilot can not see. Infrared tracker was developed and is being produced by Aerojet General Avionics Division. Company says device is "only operational infrared fire control equipment in existence today" and is in use by Air Defense Command units. Infrared tracker has advantage of not radiating any energy, thereby not alerting enemy to presence of F-104.

Titan Handling

Mitchell AFB, N. Y.—Development engineering inspection by USAF of stage handling and emplacement of the Martin Titan ICBM was made here last Monday.

Feature of handling equipment is that it is based on readily available off-the-shelf hardware. American Machine & Foundry has contract covering all launching and handling equipment.

In the demonstration a 110 ft. Cole crane emplaced Titan second stage in 7½ min. in wind estimated at 25 mph. Mockup was accurate as to weight, dimensions and balance but bore no aerodynamic resemblance to Titan configuration (AW Aug. 18, p. 33). Titan was emplaced in pit; mating of each stage is accomplished at ground level.

and more airports have progressed to the point of self-sufficiency." This, he said, refers only to day-to-day operations and does not refer to the ability to make capital construction investments and support debts already incurred.

• **That "well over one billion dollars** has been allocated by the government to the construction and improvement of local civil airports." Burnard objected that the President failed to point out that almost $800 million of this was under the "make work" program during the 1930 depression and the defense landing area program of 1941-42, "neither of which have any real relation to civil aviation of 1958."

• **That "over 500 military airport** facilities have been declared surplus and turned over to the cities, counties and states for airport use." Burnard objected that the President overlooked the other side of the coin; that during World War II, about 429 civil airports were turned over to the federal government; that, even today, well over 200 civil airports are being jointly occupied by military units, and that military transports use hundreds of additional civil airports.

Northrop, Arma Near Merger Agreement

Washington—Merger of Northrop Aircraft and American Bosch Arma Corp. will go through if the principals can agree upon a mutually satisfactory stock exchange ratio, but there is sharp disagreement on this important point at the moment.

Arma is seeking a share-for-share exchange, while Northrop is pressing for a more favorable ratio on the basis of its current year's larger sales and profits.

Statement last week by Northrop President Whitley C. Collins said that an understanding had been reached with Arma on "practically everything" but the stock exchange terms.

Collins conceded that a share-for-share exchange had been discussed but said the merger would "not necessarily call for exchange on that basis." He said exchange ratio would take account of each company's net worth and its profits.

Northrop's profits for the year just concluded will exceed $4 per share, Collins said. Arma's profits for 1957 were $2.67 per share, and its current year's are expected to be lower because of a sharp drop in the company's automotive accessory business. At mid-week, Northrop's stock was selling for around $28.50 per share, while Arma's was selling (ex-dividend) for around $27.

Arma officials believe that the stock exchange ratio should place more emphasis upon future prospects, less on current earnings. Arma holds very sizeable contracts for inertial guidance systems to be used in the Atlas and Titan intercontinental ballistic missiles and thus has a strong position in inertial guidance field.

Collins said that if the merger goes through, he would become chairman of the board, while Arma's Charles W. Perelle would become president, as earlier predicted by AVIATION WEEK (AW July 28, p. 20). Company headquarters would be on the West Coast and probably would be called Northrop-Arma Corp., Collins indicated.

An Arma spokesman said the Collins statement was released without prior knowledge of Arma officials.

Carmichael Appointed Fairchild Officer

Hagerstown, Md.—James H. Carmichael, former president and board chairman of Capital Airlines, joined Fairchild Engine & Aircraft Corp. last week as vice president for commercial transport to handle the company's F-27 turboprop sales. Carmichael resigned from Capital several months ago.

Carmichael's appointment was one of three new corporate vice presidencies created by Fairchild in a reorganization program designed to bring executive responsibilities in line with changing industry patterns.

Named with Carmichael were F. E. Newbold, Jr., former manager of the engine division, as vice president for coordination of planning and Richard C. Palmer, former assistant to President Richard S. Boutelle, as vice president of communications.

R. James Pfeiffer, former executive director of the Corporate Customer Relations Division, also was named vice president of marketing for the new Commercial Transport Division which Carmichael will head.

Nuclear Balloon Shot Scheduled by AEC

Las Vegas—First nuclear test shot of the concluding phase of the 1958 Atomic Energy Commission test program is scheduled for firing from a balloon this week. Another detonation is tentatively scheduled for firing from a 50-ft. tower Sept. 25. About half the scheduled shots will be positioned in deep underground tunnels. Tentative dates of other shots will be announced later.

A total of 10 low-yield detonations in the nominal (20 kilotons) or below nominal range are to be fired before conclusion of the program Oct. 31.

Bid for Minuteman Assembly Submitted

Santa Monica, Calif.—Bid for assembly and testing of Minuteman, solid propellant second generation ICBM, has been submitted by a team made up of Douglas Aircraft Co., Hughes Aircraft Co. and Food Machinery and Chemical Corp. As major subcontractors to Douglas, Hughes would be responsible for electronics and FMC for ground support equipment.

A Minuteman assembly and test policy board, composed of top officers of the three companies, has been formed to direct the team's proposal program. It will meet at least twice a month to establish policy and review the program (AW July 28, p. 27).

Douglas has formed a separate Minuteman division, headed by Kenneth B. Bingham, to manage the program.

United, Douglas Agree On DC-7 Trade In

Washington—United Airlines and Douglas Aircraft Co. are seeking Civil Aeronautics Board approval of a joint sales agreement allowing the airline to trade-in 10 DC-7s now in service towards the purchase of 10 DC-8 jet aircraft already on order.

Filed with the Board last week, the application covers separate agreements concluded between the airline and the manufacturer on Oct. 24 for the sale of the piston-engine equipment and purchase of the jet transports.

Delivery dates and payments for the used aircraft have been planned to allow for the purchase of the new jets, according to Curtis Barkes, vice president of finance and property for United.

Resale price of the DC-7s was set at $1,250,000 per plane, with a reduction of $5,000 for each month the aircraft has been used since its original delivery date to United.

Farnborough

By David A. Anderton

Farnborough—Second appearance of Britain's first generation of guided missiles showed some design and production refinements made during the past year, but no surprising major technical advances.

Only two completely new weapon systems—the Pye anti-tank missile and the Avro air-to-ground missile—made a first appearance. Britain's Black Knight re-entry test vehicle was scheduled to show but didn't until late on the final day after the successful firing of the first round at Woomera, Australia. Britain's Blue Streak ballistic missile has not yet been developed to the point where it is ready to be shown.

Newest of the anti-aircraft defense missile family—the Armstrong Whitworth Seaslug being developed for the Royal Navy—was displayed in the form of a test propulsion vehicle. Informed observers agreed that the final form of the missile would differ somewhat from the shape of the round displayed.

Basic change in the Seaslug, and presumably the reason for the new test vehicle, is that a solid-propellant sustainer rocket has replaced the liquid-propellant unit that has been the basic powerplant since the project was started.

Original cluster of 12 solid-propellant rockets used as wrap-around boosters have been replaced by a quartet of larger rockets fastened to missile's nose.

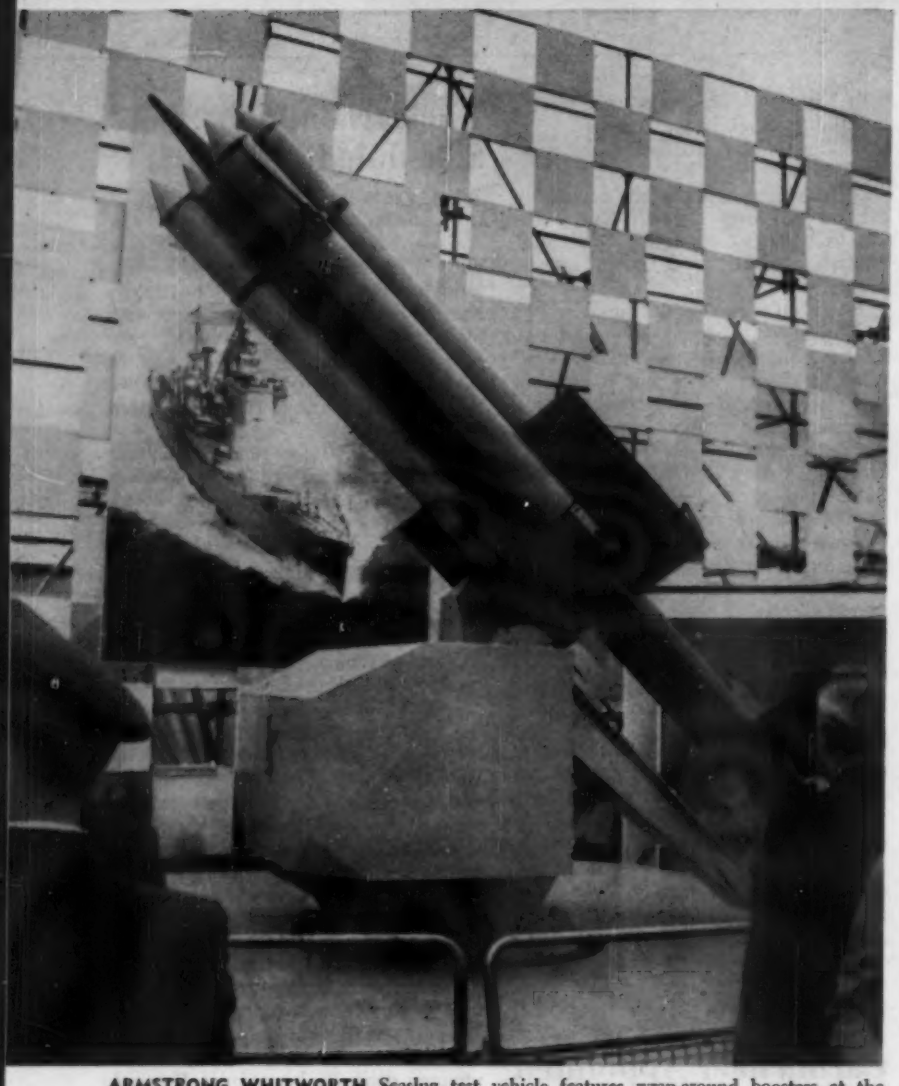
Guidance system for the Seaslug is the responsibility of General Electric Co. Ltd., and control is designed and developed by Sperry Gyroscope Co. Ltd. System is presumably beam-riding with homing in the terminal phase.

Much of the test firing has been done at sea on the missile ship HMS Girdle Ness. First round of a recent salvo of two hit the target drone and the second hit the largest piece of resulting wreckage (AW Sept. 8, p. 28).

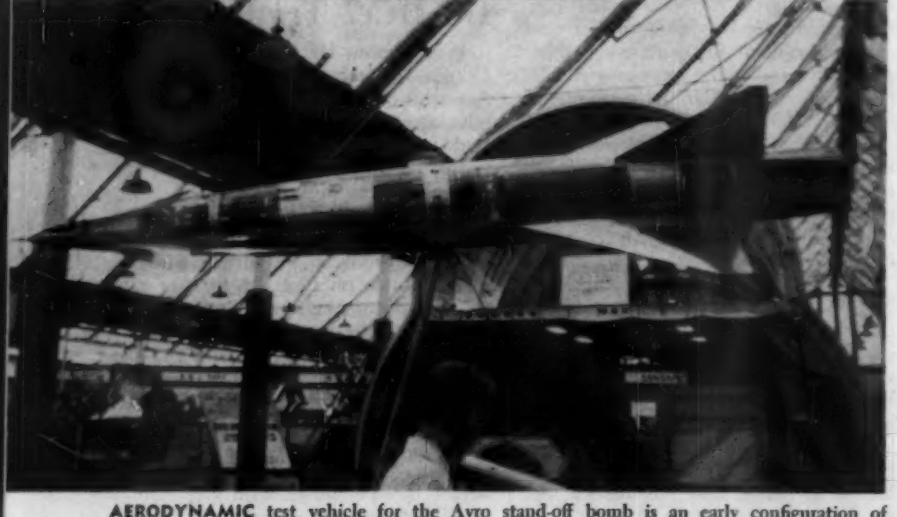
Seaslugs will become standard armament for the Hampshire class of guided missile destroyers now being built for the Royal Navy. Missiles will be fired from multiple launchers automatically fed from magazines below decks.

Major feature of three missile exhibits —Bloodhound, Fireflash and Thunderbird—was simulated field operation and checkout of rounds performed by teams of service technicians.

English Electric's Thunderbird was smartly handled by a six-man army crew under the direction of a leather-lunged sergeant. Bristol Bloodhound was manhandled and set up by a unit of Royal Air Force Fighter Command, who will have operational responsibility for deployment and operation of the



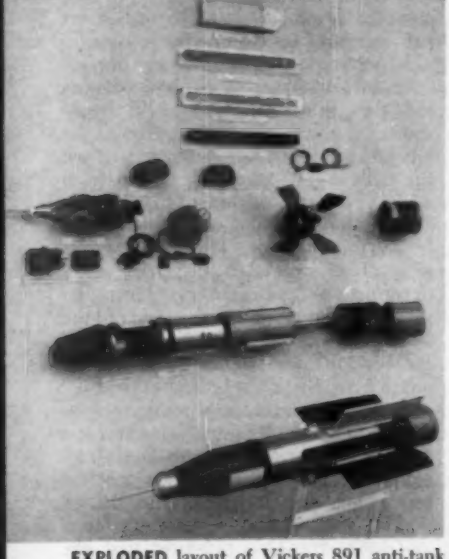
ARMSTRONG WHITWORTH Seaslug test vehicle features wrap-around boosters at the nose. Launcher is a demonstration model and not a prototype for ship-based operations of the Royal Navy's first anti-aircraft missile. Seaslug's final configuration may be different.



AERODYNAMIC test vehicle for the Avro stand-off bomb is an early configuration of RAF's first air-to-surface missile. Canard layout is used, but on the missile the wingtips have sharp negative dihedral, giving a "cranked" appearance to the planform of the bomb.

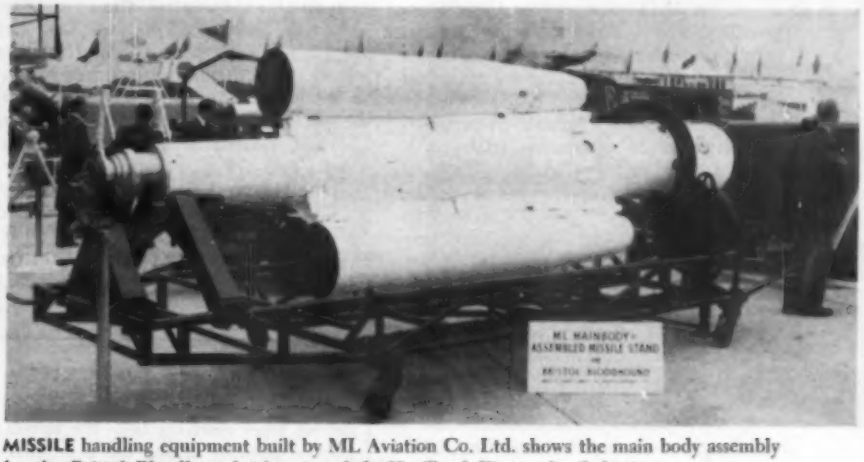
Missiles Show Refinements, No Giant Steps

PYE anti-tank missile is wire-controlled, is designed for longer ranges than smaller Vickers 891 or Nord SS-10 or SS-11.



EXPLODED layout of Vickers 891 anti-tank missile components shows miniaturized layouts of parts. Wire spool (right) is annulus fitted around rocket motor nozzle.

BRISTOL Bloodhound anti-aircraft missile now being delivered to RAF is powered by a pair of Bristol Thor ramjets. One feature of the missile exhibit was simulated field operation and checkout of Bloodhound. Missile was manhandled and set up by RAF Fighter Command Unit.



MISSILE handling equipment built by ML Aviation Co. Ltd. shows the main body assembly for the Bristol Bloodhound (above) and de Havilland Firestreaks (below).

anti-aircraft missile. Fairey Fireflash beam-riding missile was run through assembly, checkout and installation on a stub-wing section by a team of the Royal Air Force's Guided Weapons Development Squadron.

Notable in all three of these demonstrations was the complete reliance on muscles and manpower to move rounds as large and bulky as the Thunderbird on transport trolleys. Operations were done on a concrete hardstand, which made wheeling the big trailers somewhat easier than it would be in the field after a week of rainy weather.

Some American observers rated the ground equipment for British weapon systems as rudimentary. But British technicians defended the units on the basis of a different design philosophy.

Most British missile systems were designed with economy as a major consideration, they said. Much of the ground-handling equipment had to be built without motorization or automaticity applied to the maneuvering of missiles. It was simply a question of keeping the cost of the weapon system to a reasonable figure, say the British.

Two anti-tank missiles were displayed and a third announced at the Farnborough show. Fairey, whose pioneering work on beam-riding air-to-air missiles resulted in the Fireflash, announced it had the contract for the British Army's anti-tank missile. Speculation was that the weapon compares in size with the Australian Malkara recently ordered by the British for evaluation trials (AW Sept. 8, p. 37).

Next down the scale in size from the Malkara and Fairey missiles is one developed by Pye Ltd. as a private venture. About 5 ft. long and with a 2 ft. span, the Pye missile is called manportable. It is not light enough to be carried by a single soldier, however. Best estimates of its weight place the figure at 80 lb. With the missile itself goes a thumb-operated joystick control, a pair of periscopic monoculars and a 20 lb. ground computer unit and associated power supply.

Missile is set up on a light tubular structure and fired by the gunner. His thumb motions move the joystick and send course correction signals to the round through a pair of trailing wires paid out from bobbins on the wingtips. He sights both missile and target through the monoculars which switch from low to high magnification during the flight of the missile.

Powerplant is a solid-propellant sustainer and booster furnished by Bristol Aircraft Ltd.'s Rocket Motors Division. Motor exhibited had nozzles blanked off in deference to American security. Presumably this is because the booster and sustainer are annular charges made under U. S. patents. However, French-built Nord anti-tank and air-to-air missiles have a similar powerplant arrangement developed in France some years ago, and these missiles have been sold all over the world.

Pye says the missile can go into production immediately, because it has been flight-tested thoroughly on a simulator which has logged more than 50,000 flights. But visiting experts pointed out that while simulator flights have their value, a field firing program is the only way to prove final performance and operations of the missile under tactical conditions. Vickers 891 anti-tank missile, first shown at Farnborough last year, has been further refined during the past 12 months.

Major attention has centered on the pistol-grip and thumb yoke control system which evolved as a result of many studies made in human engineering.

The gunner sights through a monocular eyepiece mounted like a telescopic sight on a modified gunstock. His left hand steadies the stock and fires the round by means of an index-finger trigger. His right hand fits around a grip and his right thumb fits in a hollowed trigger which is gimbal-mounted so that all motion is around the natural axis of the thumb. Vickers engineers claim this eliminates all tendency of gunners to overcontrol these missiles.

Missile itself is 33 in. long and has an 11 in. wingspan. Weight of the missile in a metal canister which also serves as the launcher is 45 lb. A lightweight version uses a folding tubular launcher carried in a canvas bag and weighs only 35 lb. complete.

Range of the Vickers missile is about 1,250 yd., competitive with the Nord SS-11 or the Oerlikon Cobra types. Propulsion is by a two-stage Imperial Chemical Industries solid-propellant unit.

One unique feature of the Vickers model is that the wire spool is an annulus fitted around the rocket motor exhaust rather than being a wingtip bobbin characteristic of every other wire-controlled missile.

Only basic research missile or vehicle on display was the Short-Elliott GPV (general purpose vehicle) developed for research into the basic problems of homing on targets. Data from rounds fired at Aberporth test range are distributed among all British missile projects.

GPV is 26 ft. 8 in. long and has trapezodial cruciform wings of low aspect ratio with high aspect ratio control surfaces located closely downstream. Configuration was developed some time ago and standardized in a series of test vehicles for propulsion and guidance systems developed by the Royal Aircraft Establishment.

Powerplant is a liquid-propellant rocket engine developed by RAE Wescott and built by Short for the vehicle.

Elliott guidance system is a semi-active homing type, using reflected energy bounced off the target by a ground-based radar. Signals received by the missile precess a free gyro in the direction in which the target line of sight is moving and at the same rate. Pickoffs on the gyro keep the homing antenna system pointing in the same direction as the gyro axis, which is therefore pointing at the target.

Other test vehicles were earmarked for specific projects. Short showed its SX-A5, a stubby rocket exhibited last year, used as a data-gatherer for the company's development of a ship-to-air missile for the Royal Navy. The project is aimed at short-range defense of ships, and is expected to handle attacking planes that evade long-range fighters and the Seaslug medium-range missile.

Major job of this test vehicle is guidance investigation. Avro test vehicles for the Blue Steel standoff bomb showed some variations from the mockup of the weapon flown past on the belly of an Avro Vulcan and from a model of the missile displayed.

Basically the layout of the boost-glide bomb is a canard. The test vehicles were obviously aimed at getting aerodynamic and control information rather than simulating tactical uses of the weapon. Nearest U.S. counterpart of the Blue Steel is Bell Aircraft's Rascal, but official British reports indicate the weapon has considerably more range than the USAF missile. Blue Steel has been fired against targets up to 400 mi. from release point, and has touched supersonic speeds—probably on the order of Mach 1.6—at altitudes as high as 60,000 ft. This indicates that the missile is dropped from the bomber and programmed to accelerate ahead of it, climb to altitude before burnout of the motor and then glide to target.

1959 Farnborough

London—There will be sufficient new aircraft types emerging from the British aviation industry during the next three years to ensure the continuance of the Farnborough flying display, according to a survey recently completed by the Society of British Aircraft Constructors.

A formal decision to hold the 1959 air show is expected to be made by the Society's October council meeting.

A. F. Burke, of de Havilland, current president of SBAC, discussing the survey, said it revealed that 1960 was likely to be a "vintage year" for new aircraft.

The 1958 Farnborough flying display attracted a record total of 360 British aircraft and accessory manufacturers as exhibitors. Attendance topped 263,000 for the week-long show with a total of 238,000 on the three public days, 7,300 foreign guests and 18,000 from the British aviation industry.

Black Knight Re-Entry Successful In First Australian Firing Effort

By John Tunstall

London—Britain's Black Knight ballistic re-entry research rocket in a successful first firing last week at Woomera, Australia, reached an apogee of 300 mi.

Designed at the Royal Aircraft Establishment, the missile was officially stated to have exceeded expectations. Successful first firing, a design and development period of less than 30 mo. and design development and firing costs at the astonishingly low figure of $25 million are being given full play by jubilant British scientists.

Instrumented nose cone together with tape records fell near the center of a target area 50 mi. from the launching site, and was recovered within a few hours of the firing. Evaluation of the condition of the nose cone which is estimated to weigh about 20 lb., is proceeding.

Firing Profile

Black Knight has a length of 35 ft. and a diameter of 3 ft. It was controlled to climb vertically for several thousand feet, then was directed onto a climb path to the target area. After engine cut-off the missile coasted upwards in "free-fall" to its apogee.

The vehicle, fired at 8 a.m. GMT Sept. 7 telemetered data on the motor, control and guidance, and the external environment to ground receivers along the range. It was tracked optically and measurements of the re-entry behaviour were recorded.

Maximum speed of the vehicle at engine cut-off was in the region of 8,000 mph.—about half orbital speed. Whether any braking techniques were used during re-entry was not disclosed but velocity of the cone at ground impact was officially stated to be "several thousands of feet per second.

Saunders-Roe Ltd. as principal contractor was responsible for most of the development and construction and ran the static firing test site at Highdown on the western tip of the Isle of Wight.

Engine Development

Instrumentation and guidance designed by the RAE is believed to have been widely contracted. Engines were developed by Armstrong Siddeley Motors on designs evolved at Wescott.

Low cost and high fuel to structure weight ratio are principal claims made for the vehicle. According to Minister of Supply Aubrey Jones, total cost of the design, development, manufacture and firing of 25 rounds will not exceed $30 million. A variety of nose cones will be investigated in the current re-entry test program, in preparation for Bluestreak IRBM.

Use of integral body and fuel tanks is the only structural detail revealed. This detail, said Dennis Lyons, who heads the ballistic missile group at RAE, is largely responsible for the structural efficiency achieved.

Use of tie bars to relieve the airframe forward of the base of all the accelerating tension loads appears to be another feature designed to reduce structure weight. Cables anchored near the nose cone and secured to reinforced structure at the propulsion bay will confine accelerating load on the frame to this region.

Nature of the liquid fuel and oxidant are still classified. But Lyons admitted that combination was not unique among ballistic missiles. Likelihood of a kerosene-liquid oxygen combination is indicated by choice of Armstrong Siddeley Ltd. as engine makers. Armstrong Siddeley and RAE Wescott are the only two known British engine establishments to have exploited this fuel and oxidant. Models of the rocket also appear to provide for a quick release topping up point which would be an unlikely requirement for a kerosene-hydrogen peroxide combination.

Launching Frame

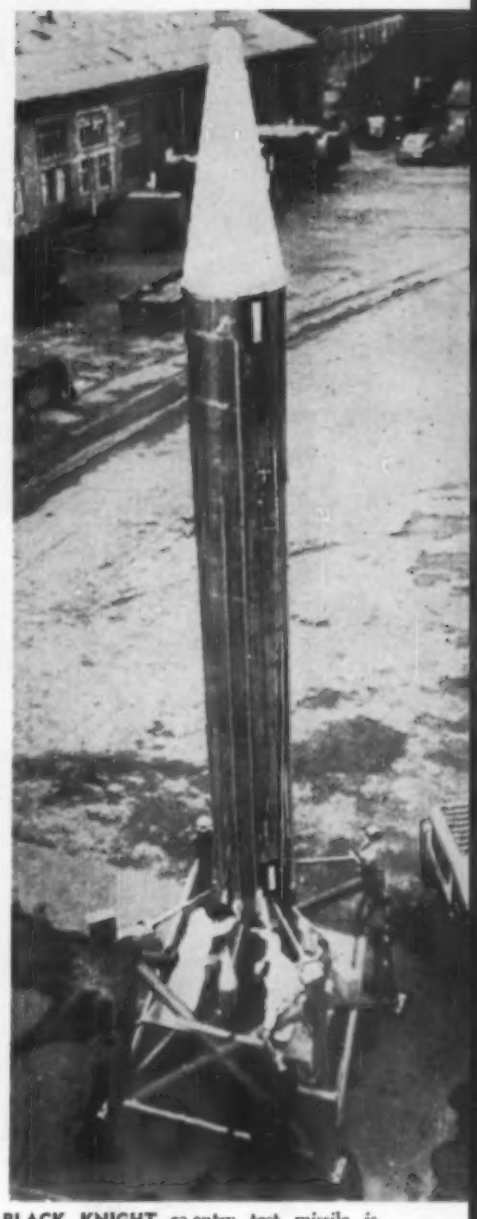
Base of the missile is supported from an elementary tubular launching frame. Very short propulsion bay shrouds, four combustion chambers and nozzles with possibly one motor gimbal-mounted provide flight steerage. Adjacent to the cone is another short bay for control and guidance equipment. The remainder, amounting to more than two thirds of the rocket, is occupied by liquid propellants.

Cruciform stabilizer fins have wedge-flat-wedge section and two fins carry the flare pods at the tips.

Within twelve months Britain hopes to achieve a height of 1,600 mi. using a Black Knight stretched to reach 600 mi., coupled with a solid fuel second stage rocket, possibly a Skylark. Black Knight with two solid stages could launch a Vanguard type satellite. But duplication of the American effort at this stage, Jones said, "is not worthwhile."

The decision to embark on a satellite program, he said, depends on the findings of the Royal Society. This body is currently pondering whether money and manpower diverted to this project justifies its scientific usefulness. Britain was looking for a route where she could "carve out her own special niche."

This might mean waiting until she could orbit a very large satellite with guidance and braking equipment for re-entry, or one capable of making comprehensive meteorological observations.



BLACK KNIGHT re-entry test missile is checked by workmen (AW Sept. 8, p. 27) before launching from Woomera test range near Canberra, Australia. Unofficial reports estimated missile might reach 300 mi. apogee; reports indicated test went according to expectations. British scientists recovered missile nose cone containing tape records. The estimated 20 lb. nose cone fell within predicted target area, some 50 mi. from the launch site.

Norway Flight Emphasizes TAC Mobility

By Evert Clark

Sola, Norway—First non-stop flight of Air Force tactical jet fighters from the U. S. to Norway and Denmark again demonstrated the Tactical Air Command's ability to deliver a combined strike force to any point in the world within a matter of hours.

North American F-100D Super Sabres flew 5,576 mi. from Myrtle Beach, S. C., to this Royal Norwegian Air Force Base and a Royal Danish Air Force Base at Alborg, Denmark, in a little more than 10 hours, refueling from Boeing KB-50J tankers near Bermuda, the Azores and Bordeaux, France.

Code-named Mobile Foxtrot, the exercise closely followed deployment of tactical air power to Formosa and came only six weeks after Myrtle Beach was used as the staging area for 18 Super Sabres on a 6,470 mi. non-stop flight to Turkey at the time of the crisis in Lebanon.

Foxtrot fighters were accompanied by six Lockheed C-130A Hercules transports of the 463rd Troop Carrier Wing at Ardmore AFB, Okla., which crossed in approximately 13 hr. flying time, stopping at Kindley AFB, Bermuda; Lajes AFB in the Azores, and Chateauroux AFB, France.

Fighter strike was to have been led by World War II and Korean war ace Col. Francis S. Gabrieski, commander of the 354th Tactical Fighter Wing at Myrtle Beach, which supplied the Super Sabres, but weather at the first refueling rendezvous forced Col. Gabrieski to land at Bermuda.

His wingman also dropped out—a situation that would not be repeated in wartime operations but which is essential to the safety planned into a peacetime exercise.

Two pre-positioned spares at Chateauroux joined the flight to replace Gabrieski and his wingman and sent four fighters into Sola and four into Alborg on the first day.

Two days later, eight more Sabres repeated the flight, again splitting to send four to each North Atlantic Treaty Organization country.

Foxtrot used five tankers, including two spares at each rendezvous.

Both groups of fighters presented air shows, including refueling, and made flyovers from Danish and Norwegian towns.

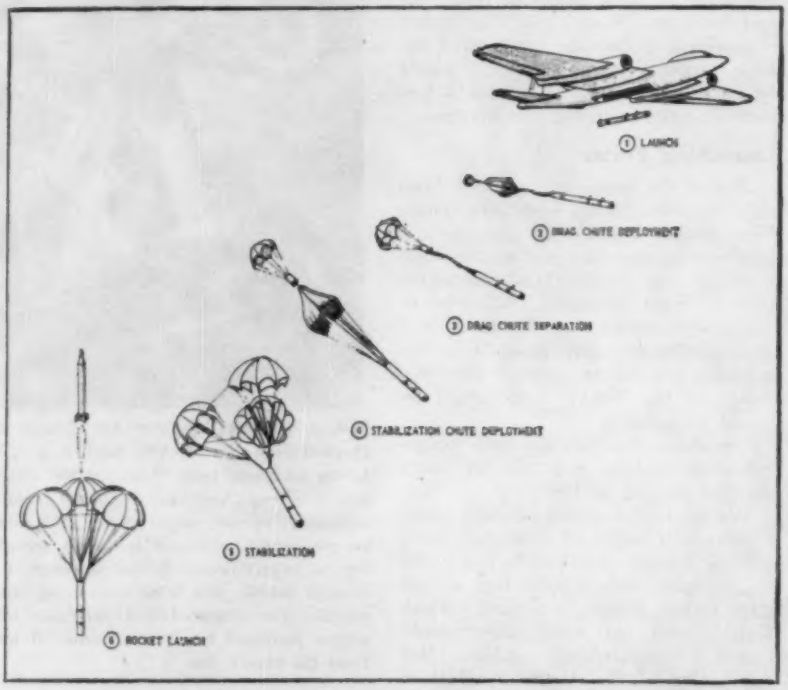
In addition to the operational realism introduced by Col. Gabrieski's abort, one Sabre in the first wave to Alborg blew a tire on landing and damaged its nose gear when it ran off the end of the runway. Two C-130s also were delayed, one with hydraulic trouble, the other for two engine changes.

The 354th Fighter Wing is named for Eighth Air Force's outstanding World War II 354th Fighter Group, which destroyed 1,000 enemy aircraft over Germany with North American P-51 Mustangs.

Flight was accompanied by Col. Hubert M. Childress, assistant deputy chief of staff for operations of the Ninth Air Force at Shaw AFB, S. C., and was met by NATO and Norwegian Air Force officials.

Four tankers flown to Sola and Alborg for static display at the air shows came from England AFB, La., and Turner AFB, Ga.

Flights involved about 125 person-



Rocket-Boosted Radiosonde to Gather Weather Data

Air Research and Development Command is developing rocket-boosted radiosonde designed to gather weather data at 29-mi. altitude. Drawing shows radiosonde launching sequence: Unit is launched from aircraft at 40,000 ft.; drag chute deploys; small charge blows outer casing free and stabilization chutes are deployed. Preset timer fires rocket to more than 150,000 ft. altitude. Nose cone separates (right) to free 10 lb. radiosonde, which falls free. Parachute stabilizes and decelerates radiosonde's descent, and unit telemeters weather data to aircraft at lower altitude. Radiosonde is being developed by Convair Division of General Dynamics Corp. Bendix Aviation's Systems Division is working on a USAF weather reconnaissance system (AW Sept. 8, p. 37) using rockets for soundings.

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The first five CL-28's of the Royal Canadian Air Force. The CL-28 is the world's most formidable submarine hunter/killer.

CANADAIR CL-28: the answer to the submarine menace *now in service*

Summer, 1958—In ceremonies attended by Senior Air Force and Navy officers of Canada and the United States, Canadair CL-28's (above) formally entered squadron service with Maritime Air Command of the Royal Canadian Air Force. CL-28's provide a new dimension of sea-safety and will meet or surpass the anti-submarine warfare requirements of friendly countries. They go into service after having been subjected to exhaustive and severe tests and trials under all climatic conditions.

The Canadair CL-28 is the world's newest long range aerial counter weapon against submarines. It was designed specifically for military planners who must think in terms of submarines that can emerge from off-shore ocean depths and launch atomic warhead missiles against targets hundreds of miles away. The CL-28 deals with the menace, and provides the capability of destroying them far out at sea, before their vehicles of destruction can be launched.

CL-28's are intended primarily for deep ocean coverage anywhere in the world and are capable of more than 20 hours endurance on patrol. They carry the most comprehensive collection of electronic and other detection equipment ever assembled into one aircraft. Once contact is made, torpedoes, depth bombs and other offensive weapons are released.

The Canadair CL-28 is now in service with Canada's Maritime Air Command and is in continuing quantity production. It offers any country materially increased anti-submarine capability. We invite inquiries.

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nel, including a 26-man maintenance crew for each group of eight fighters. Crew consists of one crew chief per plane and a pool of 16 hydraulic, electronic, instrument and armament specialists.

Fighters refueled at approximately 16,000 ft., taking on about 10,000 lb. With a 13,500 lb. full load, fighters used almost 80% of their fuel on the long leg of the trip from Bermuda to the Azores.

Four spares sent ahead to Chateauroux had planned their flight with no wind, were told at a final briefing that they would have tailwind and actually found the equivalent of no wind on the flight. Excess of headwind in this situation would have aborted the flight and possibly required bailout over the Atlantic.

Because of this possibility, flights are closely monitored by half a dozen C-54 "Duckbutts," carrying 30-man life-rafts, radio direction finding and radar equipment, and capable of staying aloft 25 or 26 hours.

First Thor Delivered To USAF in England

London—First Douglas Thor intermediate range ballistic missile was delivered to England last week. Missile was airlifted from the United States to the U.S. Air Force base at Laenheath and will be moved shortly to the first British IRBM launching base at Feltwell. The Feltwell base has been converted from an airfield to a missile launching base to accommodate the first operational Thor squadron to be based in England. The launching and servicing gear are plainly visible from the countryside surrounding Feltwell.

USAF missile handling and checkout crews are scheduled to train Royal Air Force personnel in Thor operations at Feltwell. Megaton warheads for the Thors are also scheduled to be airlifted to England, but will remain under United States control with joint Anglo-American concurrence required for their operational use. A total of 60 Thors are scheduled for delivery to Royal Air Force before the end of the year.

Douglas Consolidates Missile, Space Teams

Los Angeles—Douglas Aircraft Co., Santa Monica, has unified control of all missiles and space activities under one director at the general office level with Elmer P. Wheaton, former chief missiles engineer, heading the office as director.

A general realignment of engineering functions was completed at the same time, naming these major fields of engineering and their new directors.

- **Missiles and space systems** engineering with Elmer P. Wheaton as director.
- **Transport aircraft systems** engineering with Edward F. Burton as director.
- **Combat aircraft systems** engineering with Edward H. Heinemann as director.

All will report to Arthur E. Raymond, vice president-engineering. Appointments are effective immediately.

Former assistants of the three new directors will move up to the chief engineer positions at their divisions. Schyler Kleinhans becomes chief engineer at Santa Monica Division, L. J. Devlin becomes chief engineer at El Segundo and R. L. Johnson becomes chief engineer, missiles and space systems. A. D. Jamtaas, former engineering manager, becomes chief engineer at Douglas' Charlotte, N. C., division.

News Digest

Lockheed X-7 ramjet test vehicle exceeded Mach 4 last week in a flight believed to be the fastest ever made by a vehicle propelled by an air-breathing engine. Marquardt ramjet powered the 37-ft.-long X-7 during this flight and on one which set an altitude record for ramjet missiles.

Possible strike by Eastern Air Lines flight engineers was temporarily averted last week when Eastern President, E. V. Rickenbacker, asked for a meeting with the union this Wednesday. The Flight Engineers International Assn., which now is free to strike under arbitration procedures, agreed to the meeting.

Okanagan Helicopter Group, Canada, has ordered a Fairey Rotodyne VTOL for a price believed to be about $1 million. Order was placed at Farnborough Air Show.

The Martin Co.'s Orlando Division has been awarded a $2,438,449 contract by the Navy for the 15,000-ft.-range Bullpup air-to-ground guided missile. Number of units included in the contract was not revealed.

Boeing B-52 bombers will be equipped with new forward surveillance radar, the AN/APS-81, to supplement present tail warning and bomb-nav radars. AN/APS-81 has been developed by Light Military Electronics Department of General Electric under a contract from Wright Air Development Center.

C-130B Rolls Out

First Hercules C-130B emerges from Lockheed hangar in Marietta, Ga. Hercules has 4,000 mi. range, weighs 135,000 lb., is powered by four-bladed, 13½ ft. Hamilton-Standard 54H60 hydromatic propellers (AW May 19, p. 71), and is capable of 385 mph. true air speed. Initial test flights are due this month with deliveries to the Air Force beginning in December.

PanAm, National Draft Stock, Lease Plan

Unprecedented program could make National first domestic jet carrier if the CAB gives approval.

By L. L. Doty

New York—An unprecedented three-part agreement involving an exchange of large blocks of stock and a leasing program that could make National Airlines the first domestic carrier to introduce jet transports has been signed by National and Pan American World Airways.

The program, which will require Civil Aeronautics Board approval, includes a Pan American option to buy 250,000 shares of National Stock over a three-year period at $22.50 a share.

Here are the details of the plan filed with the Board last week:

• **Each carrier will issue** to the other 400,000 shares of capital stock in addition to the option to buy National stock granted to Pan American. All stock involved is to be vested in independent trustees pending the Board's ruling on the transfer of stock to the companies.

• **Short-term lease arrangement** provides for the rental of Boeing 707-121 jet transports to National for the next two Florida winter seasons with the first flight to begin Dec. 10.

• **Long-term lease** calls for a two-way leasing of Boeing series 707 jet transports and DC-8s for a 10 year period beginning May 15, 1960. Under the long-term rental agreement, National will lease two DC-8s to Pan American when transatlantic summer requirements are at a peak. Pan American, in turn, will lease two of its fleet of jet transports—the 707-121, 707-321 or DC-8—to meet National's winter season requirements.

National will profit from the plan in two ways: The carrier will gain a substantial competitive advantage by beating both Eastern and Northeast in the introduction of jet equipment on the rich New York-Miami route (American will be the first to introduce the Boeing 707 on transcontinental routes, see following story).

The plan also will assist National in underwriting its jet equipment program by raising equity capital through Pan American's option to buy 250,000 shares and by increasing the authorized number of shares outstanding. Wall Street circles have known for sometime prior to the Pan American agreement that National was seriously threatened with a cutback of its order for six DC-8s because of financial problems.

At present, National Airlines has an authorized capital of 1,600,000 shares of common stock of which 1,152,772 is outstanding. At its annual stockholders meeting Nov. 7, the company will increase its authorized capital stock to a total of not less than 2,500,000 shares. If the increase is approved by the stockholders, the exchange of the 400,000 shares will take place three days later.

Pan American presently has an authorized capital stock of 10 million shares of which 1,152,772 is outstanding. The carrier has no plans for increasing the number of authorized shares as a result of the National agreement.

Each carrier will receive dividends paid on the blocks of stocks held by the trustees. The agreement provides that, for a period of eight years, stock held by either company in the other will be voted in the same manner as all stock is voted.

Both the short-term and long-term lease will give Pan American its first opportunity to share in the profits of an all-domestic operation. According to one of National's top officials, the prime purpose of the stock-exchange arrangement is to create a mutual interest in the leasing plan on the part of both carriers and to provide a method whereby each carrier can profit from both the domestic and international operations.

The short-term lease will permit National to operate as many as six flights daily during the 1959-60 Florida season. Initially, the carrier will operate one flight from Dec. 10, 1958, inaugural date of service, through Dec. 15.

On Dec. 16 through April 26, the carrier will operate the Boeing turbojets with two flights daily leaving Idlewild at 9:30 a.m., and 2:00 p.m. A third flight may be added at any time experience indicates the feasibility of increased schedules.

Under the short-term lease plan, the aircraft will retain Pan American's markings, insignia and interior decor, although the agreement calls for use of seat cards stating that the plane is operated by National.

Pan American will handle all maintenance of the planes and will train National's ground and flight crews at these costs to National:

• **For ground crew training**—$1.60.

• **For flight crew ground training,** $85 per hour for a three man crew.

• **For in-flight training,** $1,290 per hour for a three man crew.

Rental rates are based on a formula involving net book value of equipment, Pan American's investment in working capital, book value of maintenance facilities plus proportionate shares of costs of depreciation, all-risk hull insurance and maintenance, overhaul and shop burden.

Under the long-term lease, the exchange of two planes each can be increased from time to time. All planes will be marked with the insignia and markings of the lessor and all maintenance of aircraft will be performed by, and at the expense of, the lessor. Any damage to the aircraft covered by insurance will be repaired by the lessee.

Lease begins with the rental of two National DC-8s to Pan American beginning May 15, 1960. Prior to May 1, 1960, the two carriers will enter into a financial agreement to determine the amount of rental charges for the aircraft.

The two carriers have operated an interchange of aircraft agreement since 1955.

American Publishes Trial Jet Schedules

Washington—American Airlines last week made public tentative jet schedules for its proposed transcontinental nonstop route now under consideration by the Civil Aeronautics Board.

Testifying in the New York-San Francisco Non-Stop Case, C.R. Speers, senior vice president-sales for the carrier, asked the Board to remove an existing route restriction which requires American flights between the two cities to stop at Chicago. CAB approval of the request, he said, would allow the airline to provide San Francisco with its first nonstop jet service to New York by January. Should the Board disapprove, he added, American will still inaugurate the first transcontinental jet flights between these cities with Boeing 707s by January, with a stop at Chicago.

American's first service with the jet transport is scheduled nonstop between New York and Los Angeles in both directions beginning in January. Other

cities scheduled to receive jet service shortly after include San Francisco, Chicago, Washington, Baltimore, Dallas and Boston.

Speers told the Board that American plans to operate two roundtrip nonstop jet schedules between San Francisco and New York with the first flight leaving New York at 9 a.m. E.S.T. arriving in San Francisco at 11:45 a.m. P.S.T.

A second flight would leave New York at 6:30 p.m. and arrive at 9:15 p.m. Eastbound, the 707s would leave San Francisco at 9 a.m., arriving in New York at 4:45 p.m. An afternoon flight would leave San Francisco at 1:30 p.m. and arrive in New York at 9:15 p.m., Speers said.

Speed of American's jets is expected to trim existing piston-engine flight time by 40% with the carrier estimating the following tentative flight schedules.

- **Los Angeles-New York**—Four and one-half hours.
- **New York to Los Angeles**—Five and one-half hours, or more than three hours faster than the fastest piston-engine schedules.
- **Los Angeles-Chicago**—Three hours, 10 min.
- **Chicago-Los Angeles**—Three hours, 50 min.
- **Chicago-San Francisco**—Four hours, five minutes.
- **San Francisco-Chicago** — Three hours, 25 min.
- **San Francisco-New York, with a stop at Chicago**—Five hours, 30 min.

Failure of the Board to lift the transcontinental restriction will virtually eliminate American from participation in the San Francisco-New York market, Speers said, pointing out that a majority of passengers will demand nonstop service with the advent of jet aircraft, and that United and Trans World Airlines, both of which oppose the application, have nonstop rights between the two cities.

Added Charter Rights Awarded Foreign Lines

Washington—Civil Aeronautics Board last week announced the amendment of all foreign carrier permits to allow the carriers to conduct off-route charter service commensurate with the reciprocal rights granted by foreign countries to U.S. airlines.

As passed by an unanimous vote of the board and defined in the CAB Economic Regulations, approval of such charter applications will be based upon standards now used in the Transatlantic Charter Policy.

The board pointed out that its action recognized the charter limitations and conditions imposed on U.S. carriers and was designed to avoid placing them in a less favorable position than their competitors.

While Board members said that U.S. carriers are held to a specific numerical limitation on off-route charters, they added that it would be difficult to impose such conditions on the foreign carriers since they are undertaking this type of charter on a broad scale for the first time. To effectively control the volume of this traffic, the CAB voted to impose a formula based upon the volume of off-route charters to the carriers' on-route operations to the U.S.

A phase of CAB examiner Paul N. Pfeiffer's decision in the Foreign Off-Route Charter Investigation recommending that any unused charter space be sold for individual fare or cargo traffic or used by company personnel, was rejected by the Board on the grounds that it might lead to "split" charters, enlarge the passenger and cargo authority of foreign carriers and result in a discrimination against charterers.

Such unused space, the Board said, may be used only for the transportation of company personnel and property.

Discussing the charter by foreign carriers of aircraft for off-route charter service to foreign air-freight forwarders, CAB said it was unwilling to prohibit such transactions in advance of a decision in the International Air Freight Forwarder Investigation.

The Board explained that it has never asserted jurisdiction on shipments inbound to the U.S. and recognizes that its actions constitute a granting to foreign carriers of a charter authority more broad than that held by U.S. carriers. It added, however, that the same situation has existed with respect to on-route charters and that no evidence had been submitted to show a need to place a restriction on foreign carriers conducting such flights.

Extended 707 Tests Ease Dispute

New York—Prospects brightened perceptibly last week for the relatively unrestricted operation of the Boeing 707 jet transport out of New York International Airport.

Left tacitly understood, but not explicitly spelled out by the Port of New York Authority in announcing a 30-day extension of Pan American World Airways 707 trail service, was that the previous 190,000 lb. gross weight restriction because of noise would not apply.

Airline officials regarded dropping of this provision as a big step toward settlement of the noise issue here, clearing the way for maximum gross load operation of the 707 when Pan American begins scheduled passenger service in November. Industry had feared drastic gross weight restrictions after the Port Authority's "My Dear Colleague" letter (AW Sept. 8, p. 39).

Pan American must observe gross weight limits imposed by the Civil Aeronautics Administration on certain runways. Maximum load take-offs have not yet been made from Idlewild and may not be tried until cooler weather arrives; however, the 190,000 lb. limit specified in the original airline-Port Authority agreement for the trial operation has been exceeded.

Tests at London Airport, made during the airplane's first visit there last week, observed the 190,000 lb. figure, but Pan American said the British were willing to permit full load operation. All that prevented it was that Harold Watkinson, Minister of Transport, had made the 190,000 lb. commitment to Parliament and could not alter it at short notice, the airline said.

British European Airways official observers told AVIATION WEEK in London that they were more concerned about blast effects than noise. These could lead to damage of servicing equipment and neighboring aircraft.

The aircraft touched down at London at 9:30 a.m. GMT last Monday and static tests were under way within two hours. Test program was carried out while dispersing the 707 between adjacent aircraft pitched on circles at 200 ft. centers.

Throttle settings were chosen to simulate various taxiing weights. They included a setting of 4% total thrust. Blast measurements as well as noise levels were specifically measured at various radii.

The aircraft made several landings and takeoffs during the afternoon and was monitored at three sound stations —two along the runway and one about 2,000 yd. out on approach.

The aircraft rose at about two-third point of the runway, climbing at 2,000-3,000 fpm., landed with thrust reversal and turned off, again about two-thirds of the way down. After some more taxiing trials it took off for Stansted Airfield, Essex, and completed circuits at full operational weight.

Nettled at implications at a London press conference that the 707 was a one-stop airplane on the Atlantic, Harold E. Gray, Pan American's executive vice president for the Atlantic Division, canceled scheduled route proving stops at Iceland and Goose Bay on the return.

The airplane made the nonstop hop in 7 hr. 29 min. at long range cruise speeds. Pan American said 2½ hr. fuel remained on landing at Idlewild and that the flight could have been made a half-hour faster if the long range cruise speeds had not been used.

CAB Opposes Plan to Adopt Surcharges for Jet Services

By Robert H. Cook

Washington—Civil Aeronautics Board last week denounced proposals by international air carriers proposing a surcharge on future jet service and urged instead the retention or reduction of present economy class fares to support the increased seating capacity offered by the new aircraft.

In a formal statement of its position, provided for the International Air Transport Assn. Conference which meets this month in Cannes, France, the Board termed the question of fare differentials for different type aircraft as "inconsistent with sound rate-making principles" and served notice that it could see no reasons to depart from this policy at present.

CAB's rate division recently rejected a tariff filing by Braniff Airways, which had requested a surcharge of 15% for jet service (AW Sept. 8, p. 38). Division spokesmen said the application was denied because of improper filing procedures and failure of the airline to spell out distinct points between which the fare would be imposed.

Noting the predicted economy of jet equipment, as compared with the present piston-engine aircraft, the Board emphasized the importance of "protecting" the opportunity to operate the new planes in a low fare service. To do so, it said, would be consistent with a CAB policy favoring the use of the most efficient and economical aircraft to provide the traveling public with the lowest possible fares.

Lower Operating Costs

Pointing out the need to fill the increased seating capacity offered by the new jets, the CAB added:

"To the extent that jets prove to be more economical, it would appear essential that this cost advantage be reflected in lower fares so as to achieve maximum development of the traffic potential, a potential which lies predominantly in the tourist travel market which is readily responsive to reductions in fares."

In line with this philosophy, Board members told IATA that CAB is convinced the substantially broader traffic base needed to sustain jet operations lies primarily in an increased penetration of the tourist market. For this reason, CAB said it is opposed to any increase in the general level of fares now applied to North Atlantic routes. To stimulate revenues in this market area, the Board emphasized a need to retain present economy class service and the retention or reduction of fares for this particular class of passenger.

Current fare levels between the U.S. and South America promise to be one of the major issues before the IATA conference but, although the CAB indicated it is aware of the competitive problems within the area, it refused to comment on the matter on the grounds that the carriers involved had failed to present any concrete proposals designed to meet the situation.

South American Issue

IATA is now in the middle of this economic strife which concerns the competition from non-member airlines serving the same territory.

As an example, Braniff Airways first-class round-trip fare between Miami and Panama is $325; round-trip tourist class, $264, and the lowest fare is $155 for a 30-day round trip tourist excursion fare.

In comparison, Aerovias PanAm Airways offers a fare of only $110 round-trip on this route complete with complimentary meals and four-engine Douglas equipment. Between Miami and Bogota, Colombia, Braniff's lowest fare is $182 round-trip as compared with the $126 fare charged by Loyd Aereo Columbiano. Between Miami and Lima, Peru, the IATA carrier's round-trip tourist fare is $473 as compared with only $280 charged by Lanica of Nicaragua using turboprop Viscounts.

Observers fear such intense competitive pressure may result in a general price war and collapse of the IATA fare levels in this market area. Recent announcement by LAN of Chile that it intends to exercise its right under the IATA charter to cut fares as a competitive measure was regarded by many observers as the only means of effectively combatting the problem other than by direct government intervention.

Discussing North Atlantic cargo rates, the Board advocated continuing development of the present specific commodity rate structure but expressed concern over the volume of traffic necessary to meet the increased capacity offered by the new jets.

To broaden the cargo market base, CAB recommended the addition of weight break-points to the commodity rate structure and a mixed consignment rule as an incentive for consolidation of mixed shipments.

The Board recommended that IATA members adopt new group eligibility standards for transatlantic charters to select only groups whose memberships are located in a limited geographical area. With groups originating in the U.S.A., the CAB suggested eligibility standards for accepting Charter Flights whereas eligible groups should have a maximum nation-wide membership of 5,000 or a state-wide membership of 10,000 and 20,000 where the organization is located in a limited area. Activities of travel agents arranging such tours, the Board said should be limited to liaison between the group leader and the carrier and to the arranging of land tours as provided by the 1958 Transatlantic Charter Policy.

In addition, the Board repeated its objections to the granting of reduced or free air transportation to cargo agents.

Pointing out its need for complete information on the deliberations of IATA conferences, the CAB said that minutes of the organization's meeting in Miami last year failed to disclose any discussion of transatlantic fares "although this matter was a major issue before the conference. Board members added that they expect IATA to include in the minutes all deliberations, formal and informal, whether or not they result in agreed resolutions."

Baltimore Proposal Opposed by Airlines

Washington—Eight major airlines serving Washington have filed objections to a Civil Aeronautics Board examiner's decision recommending that the carriers transfer 10% of their flights into Washington National Airport to the Friendship International Airport near Baltimore.

Examiner Leslie Donahue, in the Washington-Baltimore Adequacy of Service Case, made the recommendation primarily on the premise that increasing traffic volume at Washington National would make the airport inadequate within the next 18 months. Construction has begun on a new airport 20 miles to the west at Chantilly, Va., to relieve air traffic congestion in the Washington area.

The new facility has been designed to handle commercial jet flights but will not be completed for at least two years. Pending the opening of the new facility, Friendship International has been designated to handle the first commercial jet traffic in the area.

United, Trans World, National, Capital, Delta, Northeast, Northwest and Allegheny airlines protested the examiner's decision on grounds that current improvement projects at Washington National may increase its traffic capacity by 10%; that the new Chantilly facility may be ready for use before the Washington terminal becomes inadequate, and that the 40-mi. distance to Friendship would inconvenience a majority of passengers.

Soviets Push for U.S. Bilateral Invitation

By L. L. Doty

Washington—Recent and continuous prodding by top Soviet officials for talks to establish a bilateral agreement with the U.S. is being interpreted by the State Department as meaning that Russia is eager to begin Moscow-New York air service but wants the U.S. to make the opening bid.

The number of jibes by Russians on the bilateral have been increasing in recent months—an effective propaganda device in that they imply that the U.S. is dragging its feet in working towards an agreement on an air route. Such chiding has originated in top-level Soviet circles with Premier Khrushchev himself tweaking the U. S. ambassador in Moscow on one occasion for failure of the U. S. to act.

However, negotiations can begin only after an official declaration of intent to open such talks has been submitted through proper diplomatic channels and, thus far, neither country has chosen to take that step. Russia's hesitancy to make an official bid is presumed here to be tied into a propaganda philosophy that there is more world prestige to be gained by being invited than by knocking on U.S. doors.

On its part, the U.S. is struggling with a certain amount of ambivalence; it wants the service but doesn't want the ticklish problems it will create. This factor alone suggests that negotiations, which are expected to begin before the end of the year, will be drawn out and, at times, bitter.

State Department policy on civil air pact issues has strengthened considerably ever since Laurence C. Vass took over earlier this year as director of transportation and communications. This firm stand against granting unnecessary concessions to foreign carriers, contrasted to an earlier position of easy generosity, resulted in the denunciation of the French bilateral by France (AW Aug. 11, p. 31) and will certainly prevail in dealings with the Russians.

Problems facing the Communists in expanding their air routes were detailed in AVIATION WEEK, March 24, page 28.

Here are the major issues which, from the U.S. point of view, may bar the way to reaching final agreement with Russia:

• **Security factor.** The U.S. is none too anxious to open coastal defenses to aerial observation by Soviet crew members. Although the Soviet Union presumably runs the same risk, there is this difference: Russian territory would be opened to observation by U.S. pilots employed by private industry who presumably cannot be mustered into military observatory service. On the other hand, Soviet pilots serve Aeroflot, a government department that embraces all civil aviation and is directly responsible to the Soviet Council of Ministers. It is thus subject to government command, civil and military.

• **Multiplicity of designation**—State Department terminology for two or more U.S. carriers on any given route. U.S. will insist upon the right to serve Russia with at least two airlines, a policy it has attempted to follow in all bilateral negotiations. Russia, with but one airline to represent it, is expected to balk at the proposal. At present, however, only Pan American Airways is certificated to operate into Moscow.

• **Reciprocity of traffic.** U.S. will again follow an established principle that foreign cities served by U.S. airlines must have the same traffic-producing potential as U.S. cities served by foreign carriers. Whether Soviet Russia can prove to State Department-satisfaction that Moscow will generate as much traffic as New York remains to be seen.

• **Bermuda principles.** U.S. has always insisted upon the injection of Bermuda principles into its bilateral agreements with other countries and will make no exception to the Russians. Thus far, in pacts signed by Russia with England, Belgium, Netherlands, France and the Scandinavian countries, Bermuda principles have been conspicuously missing.

• **Language on airways.** U.S. will demand that English, as the universal language of the airways, be used for all traffic control and navigation procedures in Russia and the U.S. So far, Russia has been successful in demanding that the Russian language be spoken within Russia and now threatens to create a Babel on the airways by agreeing to use almost any language in other countries;

British European Airways' Comet 3B

British European Airways Comet 3B is equipped with thrust reversers and has 102-passenger capacity. The de Havilland 3B is basically a Comet 3 prototype with a Comet 4B wing configuration. Aircraft, in BEA paint scheme, was flown at Britain's Farnborough air show.

ROLLS-ROYCE DEVELOPMENTS

Jet Engine Noise Suppression

Rolls-Royce have been actively developing jet noise suppressing devices since 1950, and have accumulated a wealth of experience in the development and production of aircraft carried noise suppression systems.

Corrugated nozzles developed by Rolls-Royce, which are in production for use on the Avon engines of the de Havilland Comet 4, achieve a reduction of five decibels in the noise level of this aircraft with a penalty of less than one per cent in overall performance, and have accumulated more than seven thousand hours in flight in Comets alone. With these nozzles fitted, the Comet 4 is quieter in operation than contemporary large piston engined aircraft.

Rolls-Royce are also developing noise suppressing nozzles for the Boeing 707-420, powered by four Rolls-Royce Conway by-pass turbo jets.

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for example, Russia has agreed to use French in France and conceded to the English language in Belgium. Both Belgium and France agreed to speak Russian on Russian airways.

While these are the major hitches anticipated by the State Department once negotiations begin, there are a number of other issues, equally as thorny, that could feasibly strain discussions to the breaking point.

Economic Competition

On the subject of economic competition, for example, U.S. airline leaders are dubious over chances of ever establishing competitive standards such as fares, with the Russians. The Soviet Union is not a member of the International Air Transport Assn., which polices fare standards of its members. Although the Russians have never been invited to join the association, they are not barred from membership. However, they have never made a bid to join.

The tariff issue has been tackled by Western countries dealing with Russia by bringing the subject into the bilateral agreement. For example, the British bilateral with Russia reads: "The tariffs on the agreed service shall be agreed in the first place between BEA and Aeroflot and shall be subject to the approval of the aeronautical authorities of the contracting parties."

On the surface, this terminology may appear to be a sufficiently strong safeguard against a price-cutting war, but many U.S. airline officials think it leaves too many loopholes uncovered compared, for example to the U.S.-Netherlands bilateral pact, in which about 30% of the language of the entire agreement is devoted to tariffs.

On another point, airline leaders are wondering whether Aeroflot will attempt to penetrate the Western travel market by offering a blue-ribbon plush service which a private enterprise carrier could not afford to match because of economic limitations.

In recent years, as the Russians have branched their Aeroflot beyond the Iron Curtain, the airline has slowly become more sophisticated in merchandising its service. Although most travelers report that service standards are still below a U.S. par, there is no reason to believe that the Russians won't strive to surpass U.S. service standards. And there is just as much reason to believe they will be successful, particularly if the service program is backed by a blank check drawn on the Red treasury.

But the problem that most airline operators envision as the biggest competitive threat to U.S. carriers is the "all roads lead to Rome" strategy that underlies all Soviet maneuvers in bilateral negotiations.

In all its dealings with Western countries, Russia has carefully attempted to evolve Moscow into a universal traffic hub. And, as more bilaterals are signed with Western countries, the pattern of the over-all strategy gradually comes to light—Moscow is to be a pivotal point in air transportation. The city will be—and in fact almost is—the only aerial gateway in the world through which traffic from the Middle and Far East can be funneled to the West over the Great Circle Route.

Unless Moscow is used as a division point between the East and the West, traffic must be routed, as it is now when Western carriers are used, over the ancient trade route through the Near East and India—a route some 3,500 mi. longer between London and Tokyo than the great circle route.

Russia has eased itself into this enviable position through the simple mechanism of ignoring the Fifth Freedom provisions of the Chicago Convention. Fifth Freedom is the privilege of one country to carry traffic from a second country to a third.

Russia has accepted the Fifth Freedom principles insofar as intermediate points are concerned.

In virtually all its bilateral agreements with Western countries, it has dealt out these privileges freely and even promiscuously.

But no country has obtained a right to operate beyond Moscow in any direction. Surprisingly, Belgium granted Aeroflot the right to operate from Moscow to Brussels and beyond to Paris. However, Sabena's route stops abruptly at Moscow.

Once an agreement with the U.S. has been reached, Russia will have routes fanning into Moscow from six major capitals of the Western world. Next step is to develop a similar set of routes fingering from Moscow to the East. Having achieved this goal, not only will Moscow have become a world traffic hub, but Aeroflot will be the only airline in the world with direct one-carrier East-West service on the European Great Circle Route.

First step toward establishing air links with the East was the agreement signed with Air India. Now, Russia hopes to move into Japan.

But its first move in that direction has been thwarted temporarily by a refusal on the part of Japan to take nothing less than a direct Tokyo-Moscow route (AW Sept. 8, p. 43). However, Russia is not about to hand out to a foreign country a route that would traverse almost the entire length of the Soviet Union. What Russia wants is to establish an interchange route between Khabarovsk and Tokyo.

This would give Aeroflot its desired entry into the Far East and would prevent probing foreign eyes from scanning the Siberian landscape.

On the technical side, the U.S. will be more demanding on airworthiness standards, communications facilities and operating standards than it normally is unless Aeroflot is prepared to bow to International Civil Aviation Organization codes.

No bilateral signed between Russia and West European nations can be expected to serve as a pattern for the U.S., especially on technical matters. In fact, there appears to be no set pattern that Russia is following here.

Accident Investigation

For example, the Soviets agreed with Belgium that, in the case of an accident, investigations would be conducted by aviation officials of the country in which the accident occurred with officials of the other country acting only as observers.

Most observers were surprised at Russia conceding to such a provision and are unable to understand Russia's position in this instant. In the bilateral agreement with France, terms called for joint participation of officials of both countries in the investigations.

Eastern's Electras Near Delivery

Nine Eastern Air Lines Lockheed Electra turboprop transports receive final equipping and checking at Lockheed Air Terminal, Burbank, Calif. Delivery of Eastern's order of 40 is scheduled to begin early next month. Aircraft will seat 66 passengers.

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SHORTLINES

▶ **Allegheny Airlines'** August traffic rose to a company high of 49,300 passengers flown 8.5 million passenger miles. The carrier's cargo traffic maintained a 20% gain over August of last year, the airline said.

▶ **Hawaiian Airlines** reports it carried 51,006 passengers a total of 6,977,000 passenger miles during July for a 0.8% decrease below the same period of 1957. These figures do not include the airline's recently acquired Douglas DC-6 which has been operating under government contract carrying military passengers between California and Tokyo.

▶ **Lake Central Airlines** set a new company record during August, carrying 16,446 passengers. The mid-west carrier also flew a record seven-day period ending Aug. 29, by carrying 4,232 passengers, an 11% increase over the record 3,813 passengers carried during a seven-day period in August, 1957.

▶ **LAV, the Venezuelan airline,** has rescheduled its flights from New Orleans to Maracaibo and Caracas from overnight to daylight flights. LAV's Lockheed Super Constellations will now leave New Orleans at 10 a. m. Wednesdays, Fridays and Sundays on the nonstop five-and-one-half hour service to Venezuela. The flights will arrive at Maracaibo at 5:30 p.m., Caracas at 7:30 p.m. All times are local.

▶ **New York Airways** carried 11,143 passengers in August. Robert L. Cummings, Jr., president, says the airline will fly more than 100,000 passengers during its current fiscal year.

▶ **Qantas Empire Airways** is planning a new route from Melbourne to Fiji via Auckland, New Zealand, to compete with Pan American World Airways and Canadian Pacific Airlines which operate to the U. S. via New Zealand.

▶ **San Francisco** Public Utilities Commission has approved a contract with Welton Becket & Associates of San Francisco and Los Angeles to design an over-all plan for the complex of terminal buildings at San Francisco International Airport.

▶ **Trans World Airlines** flew approximately 500 million passenger miles on its domestic and international routes during August for the biggest month in company history. U. S. volume was up 2%, international volume 14% over August, 1957. Gross passenger revenues showed an increase of 9% over August, 1957.

AIRLINE OBSERVER

▶ **Capital Airlines will augment its present fleet with DC-6Bs in sufficient time to handle winter traffic on its newly awarded Buffalo-Florida route. Capital's pilots are being checked out now on United's DC-6 simulator in Denver.**

▶ Lockheed Aircraft Service-International has been awarded a $3.8 million contract for the maintenance, overhaul and modification of Military Air Transport Service aircraft and helicopters.

▶ **State governments will take new readings of their aviation gasoline tax structure when jet fuels are introduced by the air transport industry. Only two states—Alabama and Vermont—now tax aviation gasoline at the full gasoline tax rate but most states consistently make major moves to increase revenues by hiking tax on aviation gasoline. Over 40 state legislative bodies convene early next year and it can be expected that tax structures will be revised to include jet fuels and over-all increases may result from committee reviews of the current tax rate.**

▶ Airways Modernization Board will transfer four divisions of its Systems Analysis Directorate to the Atlantic City experimental center. Systems Analysis Coordinating Office and the Operations Division will remain in Washington and the Air Traffic Control/Air Defense Integration Division will stay in Boston where it operates in close liaison with Lincoln laboratory. To move to Atlantic City are: Analytical Simulation and Computation, Functional Analysis, Technical Analysis and Simulator Operations.

▶ **Chances that federal regulation of the air travel insurance business will be introduced next year now appear strong as a result of evidence brought out during Senate Judiciary Anti-trust Subcommittee hearings that ended Aug. 15. Charges and countercharges between airport operators and insurance companies during the hearings indicate that costs of selling insurance at airports vary widely. Airport managers are contending that all users of airport facilities must pay their pro rata share of costs of entire facility. But air travel insurance companies claim they are now paying between 25% and 75% of the gross premiums collected and that large losses in 1958 will be incurred as a result of such high rentals.**

▶ Japan Air Lines is studying vertical takeoff planes such as the British Fairey Rotodyne to operate between downtown Tokyo and Tokyo International Airport. Lead time on the carrier's plans to operate round-the-world jet transport flights has been moved up to 1963 from the original 1965 target date.

▶ **International Air Transport Assn. traffic conference beginning Sept. 23 in Cannes, France, may turn out to be more than a "review" of international fares and rates. Demands for a general overhauling of the present rate structure have been increasing during the past year because of the rising expense level and diminishing profit margins. Now that the pattern of international air travel has been fairly well established, many airline leaders are looking for a rate structure that will boost traffic on lightly traveled routes, attract new traffic on the more popular routes. Because of the imminence of jet operations, Cannes may be the place at which such a program will be touched off.**

▶ American Airlines and Allegheny Airlines will transfer their Detroit operations from Willow Run Airport to Detroit Metropolitan Airport, October 1. Split among the scheduled carriers as to which airport will be used has existed for several years and there appears to be little chance of resolving the difference in the near future. The eight scheduled airlines remaining at the Willow Run Airport are apparently determined to stay there despite the American-Allegheny moves. Detroit Metropolitan is also served by Pan American and BOAC.

▶ **Watch for a substantial increase in available seat miles on transatlantic routes during the November-March winter travel season compared to the same period last year. Initial scheduling plans of larger carriers indicate the increase may be as much as 10%.**

The Business of Versatile Helicopters . . .

One of the primary objectives of the Army's growing aviation program is to execute its many aerial missions with the *fewest possible aircraft types*. The necessity of this consolidation in terms of logistics and over-all economy is underlined by the continual increase in the number of missions to be tackled on the nuclear battlefield.

The Army's **H-23D "Raven"** meets that multi-mission requirement in the light helicopter category. Its versatility is attained by a performance, a load and space capacity, and a ruggedness to perform its tasks without compromises or limitations.

Hiller has now applied a new 305 hp engine to the basic H-23D ship. The resulting 12E aircraft—the most powerful in the two to four place class—is prepared to capture a whole new order of missions, many of them not previously considered within the realm of light helicopters.

HILLER AIRCRAFT CORPORATION
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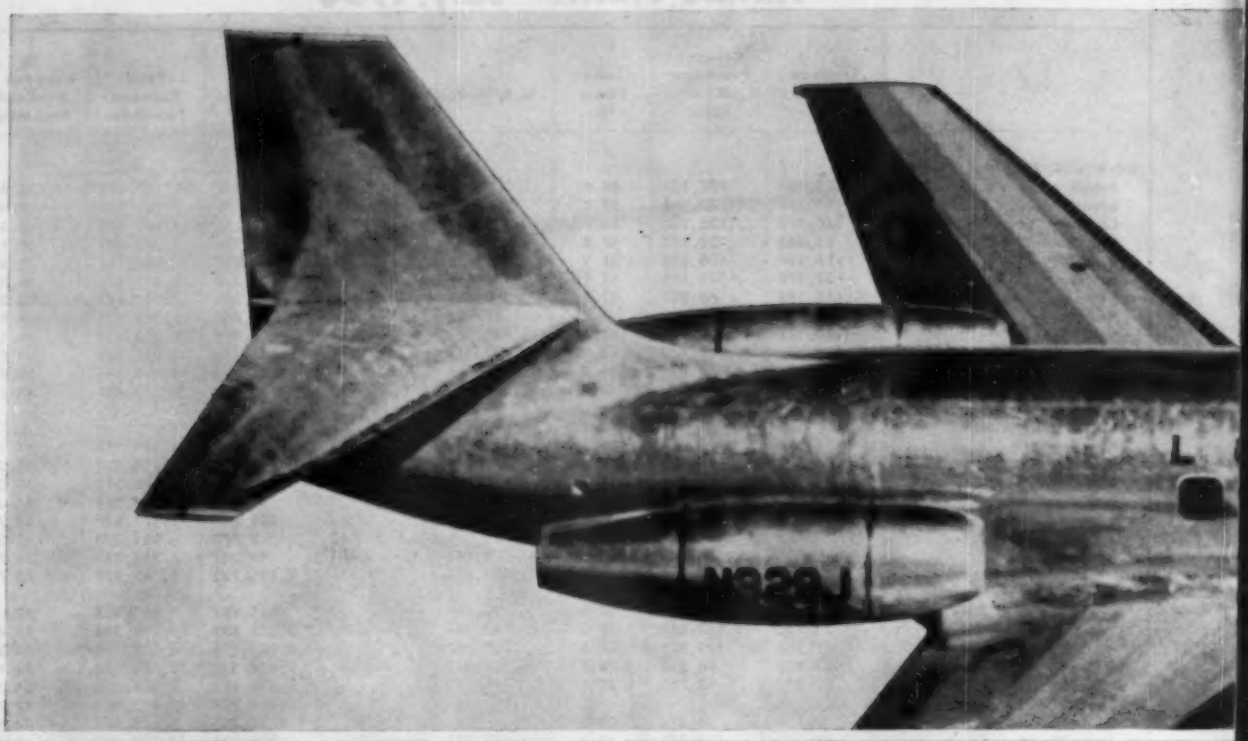
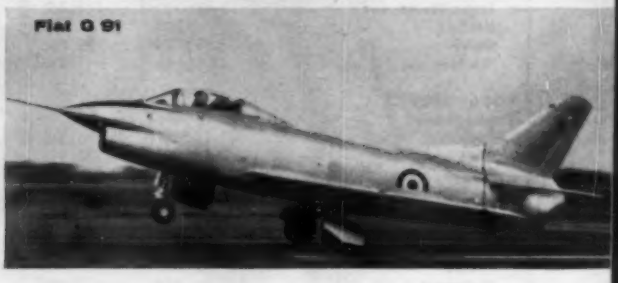
Airline Traffic — July, 1958

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	% Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	615,185	757,854	66.6	1,670,291	746,892	7,404,044	53,750,022	56.4
Braniff	165,284	72,549	55.9	297,252	158,626	543,578	7,960,239	46.4
Capital	320,172	126,200	53.7	508,447	264,594	347,211	13,209,202	44.5
Continental	75,462	39,775	47.6	102,491	37,516	186,901	4,143,617	40.6
Delta	216,969	106,895	55.3	394,976	248,121	985,287	11,890,192	50.6
Eastern	629,379	343,125	51.33	970,760	429,561	1,114,558	35,412,806	46.28
National	112,188	65,901	51.0	250,459	41,609	454,008	7,112,087	43.2
Northeast	92,208	32,360	46.0	63,375	26,890	95,813	3,286,317	38.0
Northwest	140,537	110,972	57.7	439,986	208,158	775,979	12,059,738	49.5
Trans World	394,789	367,470	68.2	1,127,512	572,117	1,996,116	38,918,748	60.0
United	591,682	464,028	64.4	2,336,544	857,658	5,185,996	52,928,175	56.2
Western	112,475	60,946	53.8	215,239	70,746	194,975	6,317,403	43.5
INTERNATIONAL								
American	11,410	10,477	55.0	8,794	435	274,307	1,379,136	57.3
Braniff	4,357	8,098	52.3	15,222	.....	108,988	1,006,229	46.8
Caribbean-Atlantic	23,997	1,673	63.18	1,387	.....	3,229	180,370	70.38
Delta	5,012	5,768	52.3	7,852	.....	38,753	679,596	45.2
Eastern	44,372	63,067	60.16	91,732	.....	103,883	6,673,015	61.31
Mackey	9,773	2,027	41.3	.....	62	2,770	221,243	41.3
National	9,507	6,279	65.3	9,268	5,684	42,267	724,247	56.7
Northwest	14,761	35,710	64.9	1,076,318	17,319	1,133,732	6,003,177	73.7
Pan American								
Alaska	6,058	6,725	67.8	29,155	.....	133,484	844,426	57.9
Atlantic	129,758	182,079	65.0	1,141,289	.....	2,379,683	22,429,268	61.9
Latin America	119,504	129,127	70.5	369,687	.....	4,088,178	16,351,623	66.5
Pacific	25,395	94,536	79.3	1,066,612	.....	1,808,552	12,746,078	75.4
Panagra	10,827	13,732	51.4	71,022	.....	450,212	2,019,715	54.7
Resort	.....	.....	....	.....	.....	3,442,964	3,442,964	78.3
Trans Caribbean	9,178	18,374	95.2	.....	.....	19,421	1,626,811	88.5
Trans World	40,239	116,366	62.1	1,002,425	.....	728,034	13,752,056	60.4
UMCA†	209	69	51.1	.....	.....	703	8,153	54.9
United	11,784	29,035	67.2	163,639	.....	118,496	3,252,030	65.5
Western	1,048	1,633	31.5	882	.....	3,062	181,910	35.6
LOCAL SERVICE								
Allegheny	45,496	8,190	48.6	10,571	19,013	17,589	828,821	48.0
Bonanza	14,892	3,350	42.4	5,097	2,789	7,385	336,116	40.8
Central	12,651	2,410	33.8	5,998	3,166	9,039	349,044	30.3
Frontier	22,716	5,170	46.4	16,004	7,327	50,968	571,460	53.8
Lake Central	13,902	2,180	35.0	3,473	13,934	.....	226,045	37.7
Mohawk	35,598	7,054	47.2	7,819	14,022	13,209	708,569	47.4
North Central	67,912	12,140	48.3	23,760	32,612	.....	1,219,870	48.5
Ozark	35,079	5,920	43.8	9,812	17,156	15,104	606,681	45.5
Pacific	32,806	7,146	50.7	11,261	4,076	5,561	703,269	48.7
Piedmont	35,876	7,589	53.1	14,625	12,274	13,620	767,679	52.7
Southern	17,661	3,273	37.2	7,973	8,557	9,522	339,769	37.4
Trans-Texas	20,397	4,622	38.1	15,041	7,315	29,050	494,151	39.0
West Coast	23,024	4,049	48.79	4,242	2,627	8,166	401,635	46.39
HAWAIIAN								
Hawaiian	49,382	15,345	75.7	4,338	.....	148,214	1,528,708	69.5
Trans Pacific	22,273	3,146	63.6	728	.....	7,964	261,128	62.7
CARGO LINES								
AAXICO	.....	.....	....	4,445	11,094	2,768,160	2,783,699	73.80
Aerovias Sud Americana	.....	.....	.....	.....	.....	712,950	712,950	87.1
Flying Tiger	10,619	50,266	100.0	32,193	30,930	7,271,728	12,361,434	89.1
Riddle								
Domestic	.....	.....	....	19,959	24,928	1,319,850	1,364,737	66.6
International	.....	.....	....	.....	.....	553,390	553,390	72.6
Seaboard & Western*	.....	.....	....	.....	.....	.....	.....	....
Slick	2,194	14,984	96.37	.....	.....	67,720	1,566,104	96.37
HELICOPTER LINES								
Chicago Helicopter	9,550	176	34.3	1,258	.....	.....	18,037	26.0
Los Angeles Airways	3,085	115	56.7	4,077	1,578	.....	16,756	62.3
New York Airways	8,902	169	46.8	1,435	784	441	18,734	44.6
ALASKAN LINES								
Alaska Airlines	5,789	4,046	48.2	54,390	.....	328,701	801,801	50.7
Alaska Coastal	6,932	595	63.0	3,731	.....	5,149	69,320	63.6
Cordova	1,197	308	57.7	3,820	.....	26,769	62,138	57.8
Ellis	7,395	389	57.97	1,800	.....	3,184	44,402	66.22
Northern Consolidated	2,902	850	51.1	23,714	.....	87,042	203,277	63.6
Pacific Northern	14,331	14,055	63.5	99,655	5,623	308,609	1,928,872	68.2
Reeve Aleutian*	.....	.....	....	.....	.....	.....	.....	....
Wien Alaska	6,020	2,195	30.5	34,024	.....	191,670	448,427	59.5

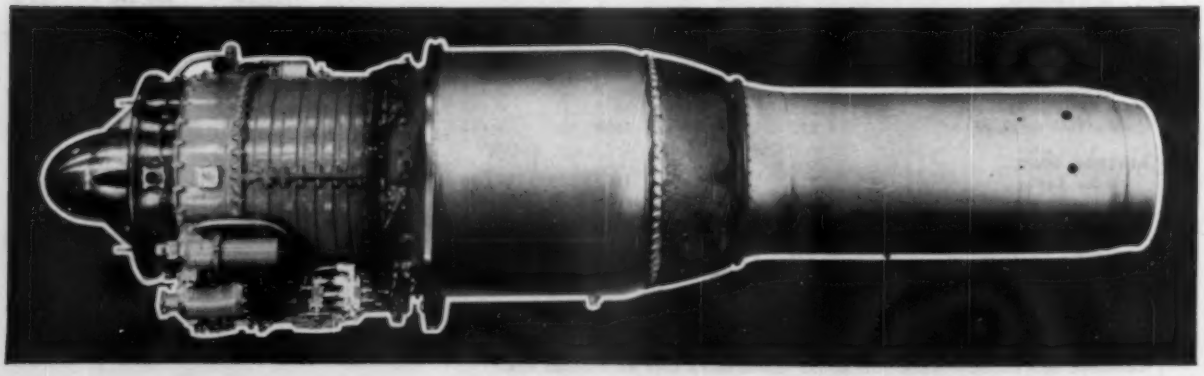
*Not Available. †Uraba, Medellin & Central Airways.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.





WORLD'S DESIGNERS SPECIFY **ORPHEUS** POWER

in fighters, strike aircraft, executive transports, and trainers



Lockheed CL-329 Jetstar

Folland Gnat

Dassault Etendard VI

Orpheus-powered Jetstar circuits the States on 18-hour demonstration flight

Taking off from Edwards Air Force Base in California, the prototype Orpheus/Jetstar touched down in Washington, then in Massachusetts and Florida. Only 18 hours after leaving Edwards, the Jetstar returned to base. It had completed its round tour in 15 hours flying time at an average 440 mph.

The current Orpheus 3 is rated at 4,850 lb and has the outstanding thrust/weight ratio of almost 6:1. The Orpheus 4, the trainer version, is rated at 4,230-lb thrust; it is designed for the lowest possible fuel consumption and long overhaul life.

Dimensions Orpheus 3: Length 75.5 in; Diameter 32.4 in.

MOST ADVANCED TURBOJET IN ITS CLASS

Orpheus development continues. The latest version, the Orpheus 12, has a still higher power/weight ratio, giving 6,810-lb thrust dry, over 8,000-lb with Bristol simplified reheat.

Versions of the Orpheus power—or are specified for—the following aircraft:—

Lightweight fighters/strike aircraft

Folland Gnat	UK, INDIA, FINLAND, YUGOSLAVIA
Fiat G 91	ITALY
Dassault Etendard VI	FRANCE
Breguet 1001 Taon	FRANCE
Hispano HA 300	SPAIN
Aerfer Leone	ITALY
Dassault Etendard IV (alternative engine)	FRANCE
Sud Aviation Baroudeur (alternative engine)	FRANCE

Executive transport/ crew-readiness trainer

Lockheed CL-329 Jetstar*	US

Trainers

Folland Gnat Trainer	UK
Fuji TIF 2	JAPAN
Fiat G 91 T	ITALY
North American Model 249 (alternative engine)*	US

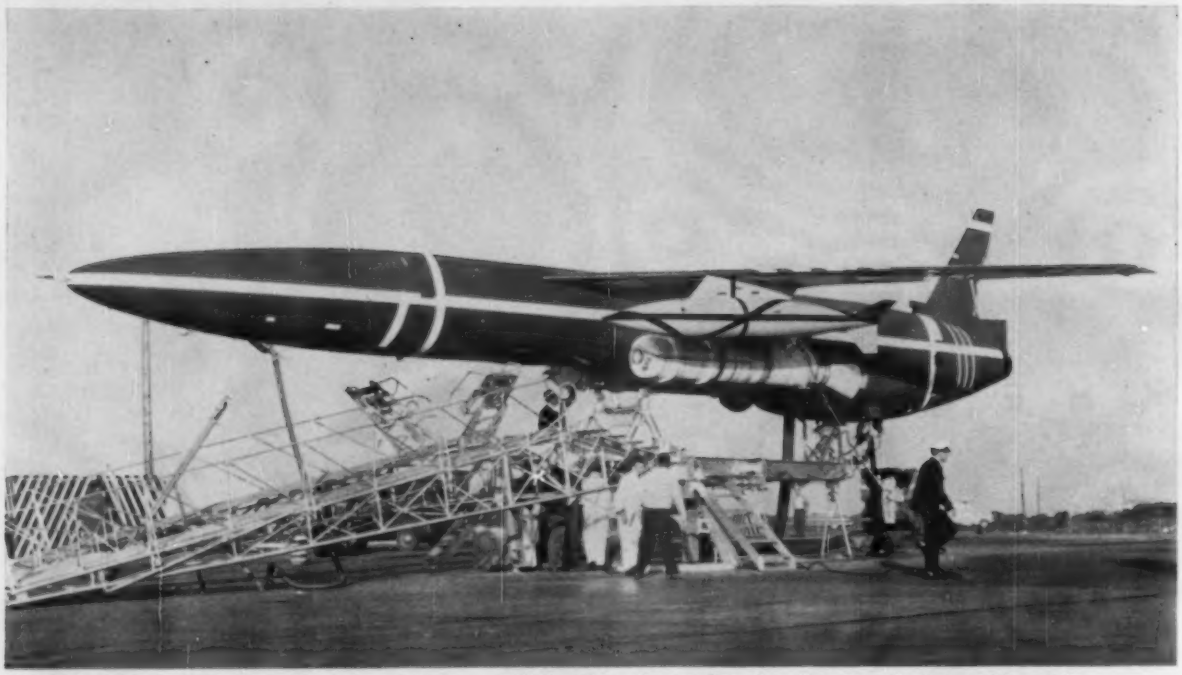
Research Aircraft

Short SB-5	UK

*Production versions of the Jetstar and Model 249 are being offered with Wright TJ 37 engines. The TJ 37 is a derivative of the Orpheus, jointly developed by Bristol and Curtiss-Wright.

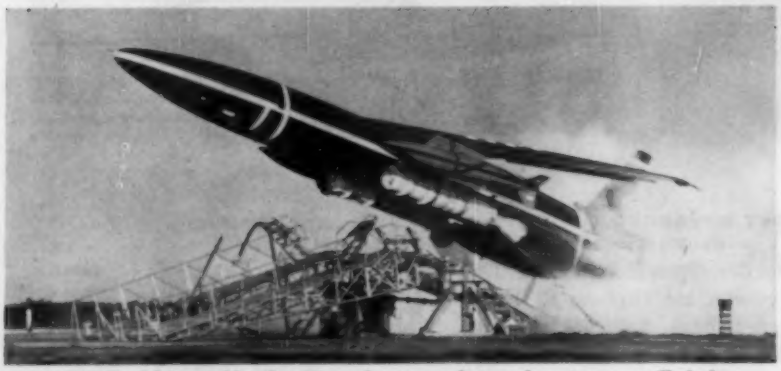
Bristol Siddeley

ENGINES LIMITED



NORTHROP Snark intercontinental cruise missile is readied for firing from a launcher that gives it high field mobility.

Subsonic Snark Adds Effectiveness to



AT INSTANT of firing, cables that trigger booster rockets under wings are still slack.

HIGH thrust rockets are fired when cables tighten. Rockets are later jettisoned.

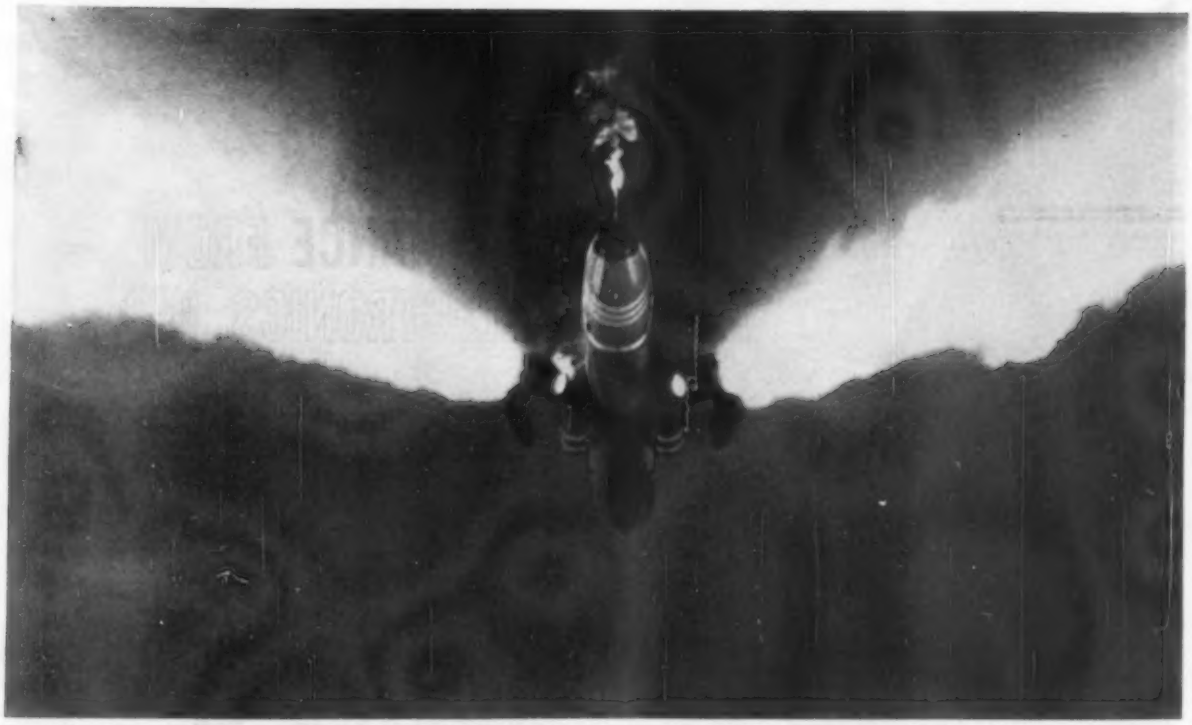
By Russell Hawkes

Los Angeles—Northrop SM-62A Snark intercontinental cruise missile, now entering Strategic Air Command's inventory of combat-ready weapons, is seen by its maker as a valuable means of increasing the effectiveness of manned bombers and ballistic missiles as well as an effective strike weapon in its own right.

Although it is lightly regarded in some quarters because it is an easy target compared with a ballistic missile, Northrop officials deny that Snark's vulnerability in single combat is an issue. They argue that bombers and missiles will be sent in coodinated raids and that the vulnerability of a force should be judged only by the cost required to send sufficient numbers to destroy the target.

They point out that Snark is certainly not an easy target for the presently existing Soviet defense. Northrop says facts supporting this claim are:

• **Current military search radars** are unable to detect Snark at ranges beyond 50,000 ft. from any angle (AW Aug. 18, p. 63) because of small reflecting areas. Tracking or fire control radars will get a return from Snark because power is concentrated in a narrow beam, but narrow field makes them virtually



REAR view of Snark firing shows rocket boosters at full 260,000 lb. thrust potential. Condensation above tailpipe is excess fuel.

SAC Forces

useless for early warning or target acquisition purposes.

• **If Russian search radars** become effective enough to detect Snark at altitude, it is possible to adapt it to low level target runs which keep it beneath line of sight from ground radar. According to testimony before the Senate Preparedness Investigating Subcommittee, Snark can approach the target at an altitude of 500 ft. At high subsonic speed, it would be theoretically possible for Snark to be detected 30 mi. or 4 min. from a ground-based radar site at this altitude but owing to the effects of ground clutter it should be possible to close to within 6 mi. or less than 1 min. of a radar located dead ahead before being detected.

• **Snark is capable** of some deviation from a direct course to the target to complicate an interception problem. This ability is limited by guidance error build-up in radical or repeated course changes.

• **Snark is at least as fast** as current operational manned bombers. Its nose section separates from the rest of the missile to make a supersonic plunge along ballistic trajectory to target.

Destruction of targets behind enemy defenses will always be a probability problem in which a calculation must be made as to how many aircraft or missiles must be committed and perhaps sacrificed to guarantee success. As the number of attackers in a raid increases, the likelihood of penetration improves for each one as enemy tracking radars and Ground Control Intercept facilities approach saturation.

Strategic philosophy behind Snark envisages its use in conjunction with manned bombers to force enemy to spread and distract his fighter aircraft and to saturate his local missile and anti-aircraft defenses around the target. Since sacrifice of U. S. missiles or aircraft is inevitable, Northrop argues that a strong leavening of low cost Snarks in the attacking force can contribute to saturation of defense without entailing the loss of as many costly bombers and irreplaceable crews.

Unmanned Snark cannot match the accuracy or warhead yield of large bombers, but its weight is only about one-eighth that of an intercontinental bomber and its price should bear approximately the same relationship

MISSILE gets final check at Cape Canaveral, Fla., launch site before engine runup.

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if cost per airframe pound can be brought down to a comparable figure. At present, Snark has not moved as far along the learning curve as any operational bomber so its cost per airframe pound is higher.

Snark Uses

Several possible ways of using Snark have been reported in congressional committee hearings and other possibilities are obvious. Cruise control of Snark can be programmed to make time-coordinated penetrations with other missiles and aircraft. If Snarks in the force preceded manned bombers, their warheads could be designed to detonate upon destruction of the missile. This would create a progressively lengthening corridor of destroyed defenses ahead of the bombers. In many cases it might be best to plan Snark missions with the deliberate intent of destroying defenses.

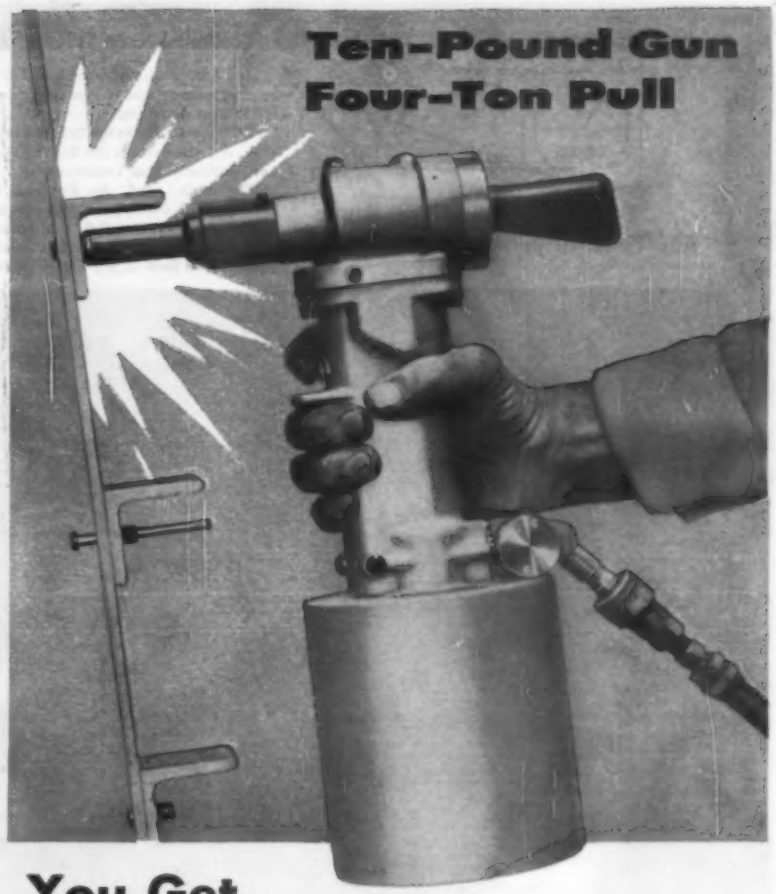
Electronic countermeasures capability was not one of the original requirements stated for Snark but, like any other load carrying airplane, it has this potential. It is possible, for instance, to install a radar homing terminal guidance system to take control and guide the missile to any tracking radar which might illuminate it but program the stellar-inertial navigation system to destroy a known industrial or military target if tracking radars fail to lock on.

Northrop planners feel Snark may find its greatest usefulness against industrial targets which are relatively easy to find and destroy but extremely well supplied with local missile defenses. Published estimates indicate that from 15% to 35% of Soviet industry is concentrated in two massive complexes around which most of their missile defenses are sited. Northrop argues that it is uneconomical to sacrifice invaluable bombers against these targets which can be destroyed by cheaper missiles. This would save the bombers for use against targets requiring heavy warhead payload and pinpoint accuracy which no long range missile possesses.

Strategic Analysis

In their strategic analyses, Northrop has assumed that the quality of Soviet air defenses is at least equal to our own. They estimate that a good percentage of a coordinated Snark raid could penetrate to the target. Soviet interceptor capability is considered relatively good. Surface-to-air missile capability is believed limited but heavily concentrated around industrial centers. This balance can be expected to change and some tacticians believe local missile defenses will surpass interceptors as a threat to U. S. bombers in about 1965.

Best mixture of weapon systems in a raid and best offensive tactics at a



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The new Cherry G-85 lockbolt gun is designed to give you maximum pulling power with less weight. Its simplified rugged construction assures low maintenance costs. The gun weighs only 10.5 pounds, which reduces operator fatigue.

No special air supply is required with this lightweight gun, because it develops this high capacity at normal line pressure.

As the leader in the field of special aircraft fasteners, Cherry Research and Development department has produced this new lightweight, high capacity gun to increase the efficiency of installing lockbolts.* The G-85 gun may be adapted for setting stainless steel, monel, aluminum and carbon steel Cherry blind rivets.

For information on the new Cherry G-85 gun write Townsend Company, Cherry Rivet Division, Post Office Box 2157-N, Santa Ana, California.

*Licensed under Huck patents RE22,782; 2,114,493; 2,527,307; 2,531,048; 2,531,049 and 2,754,703

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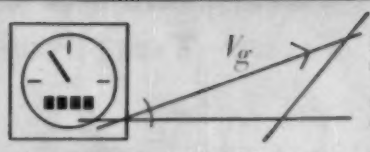

Ground Speed & Drift Angle
Any Time, Anywhere, Any Weather

One look and the pilot KNOWS. In a glance he reads actual ground speed and drift angle.

This vital data, never before available, is displayed on the flight panel automatically and continuously.

The dials "read" the key unit in GPL's revolutionary Doppler auto-navigation systems. Other phenomenal units in these systems tell where you are and how to get where you're going. The systems operate entirely without ground aid or celestial fixes, have proved themselves globally in millions of operational miles.

GPL's auto-navigators were developed in conjunction with the Air Force (WADC). They are the result of GPL's harnessing of the Doppler-effect to air navigation — an achievement comparable in magnitude to the breaking of the sound barrier.

RADAN—jet-age windsock

Spotting and dodging headwinds, riding time-saving tailwinds, are easy now for both the military and civilian pilot.

The reason is RADAN.*

RADAN navigators are members of the famed GPL family of self-contained Doppler systems. RADAN gives the pilot accurate ground speed and drift angle, two facts that add up to accurate knowledge of the wind at *his* position and *his* altitude!

RADAN systems provide military pilots with continuous velocity, second by second, help to accomplish successful missions. To the civilian pilot, they provide pinpoint navigation, savings of precious jet fuel, a priceless margin of safety.

RADAN systems, recently released for civilian use, are now in quantity production . . . ready and available to everyone.

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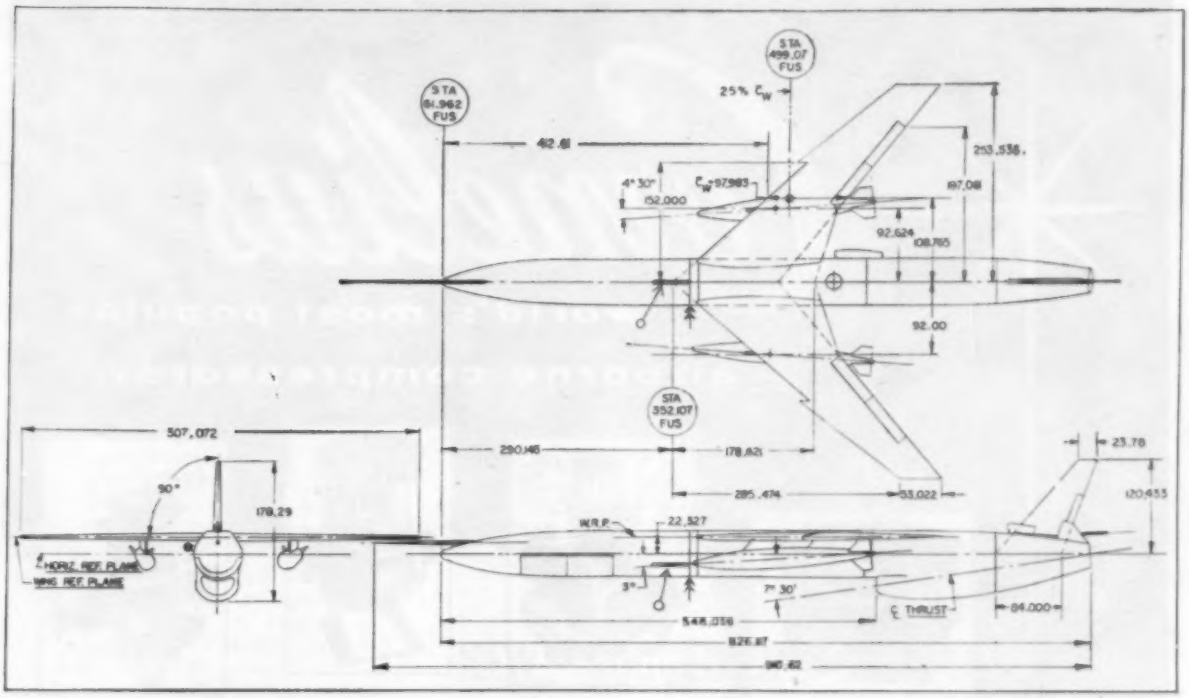


THREE-VIEW drawing of Northrop Snark missile emphasizes high, swept-back wings, large intake for Pratt & Whitney J57 turbojet engine. Single-barbed arrows indicate slots for warhead fins; double-barbed arrows show position of warhead separation line.

given time are largely determined by this balance in the effectiveness of local and area defenses. Planned separation in time and distance between attackers spreads interceptors thin, forces them to spend fuel and time traveling from one part of the defended area to another and demands that part of them be kept fueled and on the ground to protect against latecomers. When held in reserve they are more vulnerable to attacking bombers.

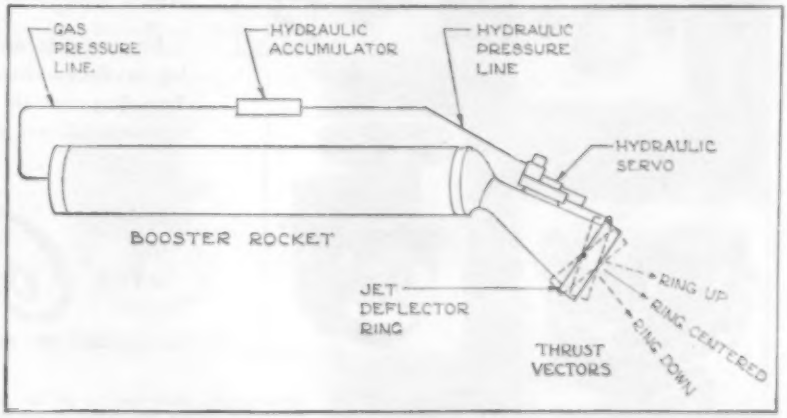
If the attacking force is in sufficient numbers, the Ground Controlled Interceptor system can be saturated and forced to abandon the more effective close control in favor of broadcast control in which fighters are informed of the location of attackers but are not vectored into firing position.

Against local missile defenses, simultaneous penetration of a large number is best since the aim is to place enough attackers over the target to approach or exceed the number which can be tracked by the available fire control radars. Russian surface-to-air missile intallations have a remarkable rate of fire.

With the advent of long range ballistic missiles, one role of Snark would be to force the enemy to split air defense funds and productive capability to provide a variety of defensive systems. Another would be to provide an intermediate degree of accuracy and flexibility between the big rockets and manned aircraft at a lower cost than either.

Vulnerability of a base or launch site to enemy action is a major factor in the effectiveness of a force since it could well determine what percentage of the force would survive to retaliate. Like the offensive problem, defense is a probability game in which the chance of success rises as the number of attackers brought to bear on one aiming point falls. Some experts have testified that Strategic Air Command is vulnerable to between five and 10 long range missiles per aiming point. Advent of Minuteman and Polaris will improve security of SAC bases markedly. Mobility of Polaris ships and comparative ease with which Minuteman sites can be "hardened" (necessary strength to withstand blast wave over pressure) and hidden will demand a disproportionate number of enemy bombers and missiles if their destruction is to be guaranteed. Dispersal in small groups will multiply the number of aiming points which Soviet Union Strategic Air Command (SUSAC) must hit, thereby reducing the percentage of its total strength available for use against bomber bases and logistic facilities.

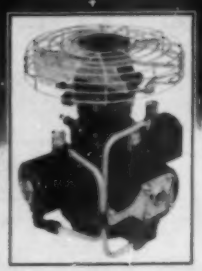
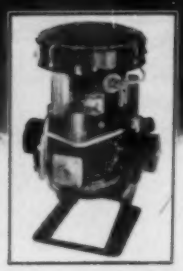
Polaris and Minuteman should be reaching service in significant numbers in about 1965. First fleet and squadron deliveries are expected in 1963, but military experts have said missiles do

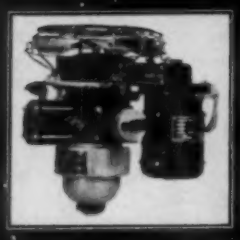


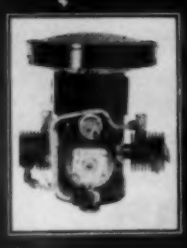
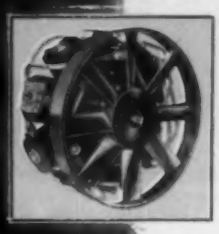
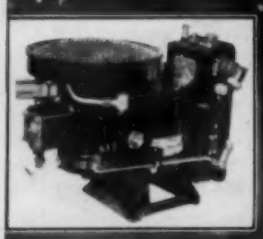
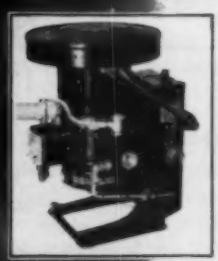
ROCKET boosters develop 130,000 lb. thrust each, burn out in 4 sec. Gases tapped from booster case pressurize 50 cu. in. accumulator to 1,000 psi. Unit is called Jetavator.

Cornelius

world's most popular airborne compressors...



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*Photographs show but 10 of the 36 different Cornelius compressors available.

Cornelius

WHEN IT COMES TO COMPRESSORS . . . THERE IS NO SUBSTITUTE FOR EXPERIENCE

not become true weapons until after about three years of firings by military personnel alone. The switch to solid propellants and growing military experience with big rockets could reduce that figure.

Northrop officials suggest that easily dispersed zero-length-launched Snark can also force an enemy to spread his strategic missile and air forces and can be delivered in quantity at a much earlier date. Whitley C. Collins, president of Northrop, testified before House and Senate subcommittees that the production rate could be increased to 36 Snarks per month without any new facilities. At the beginning of calendar year 1958 the production rate was two per month.

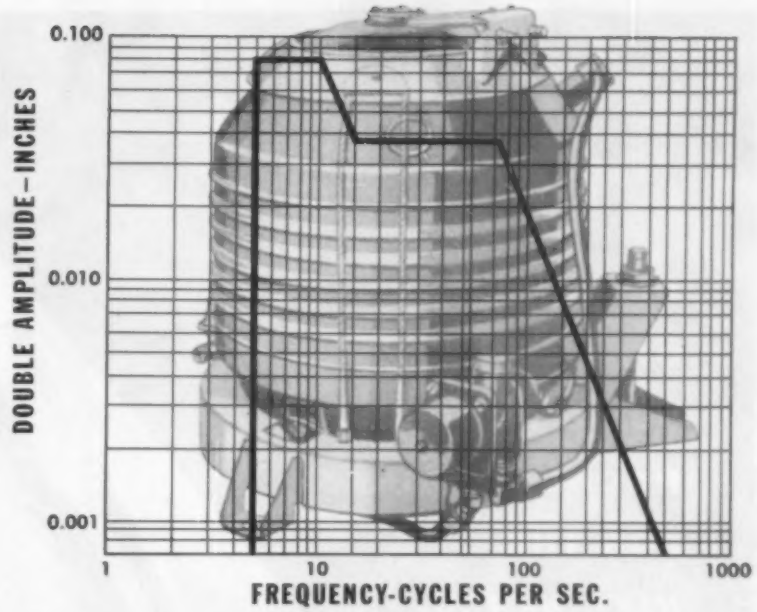
Northrop is now comparing the defensive value of dispersal and "hardening" of Snark sites in terms of the ratio of U. S. expenditure to the stress placed upon the SUSAC offense. Base hardening consists of using the traditional methods of entrenchment and fortification with iron and concrete to force the enemy to use a larger proportion of his missiles to guarantee an acceptable probability of scoring a close enough hit to neutralize the base. Alternative possibility is to divert part of his manned bomber force to get the advantage of the bomber's greater flexibility, accuracy and ability to carry a larger warhead.

Northrop experts suspect their comparison will show some advantage in favor of dispersal or a compromise between dispersal and hardening. While increasing the number of Snarks stationed at a given site makes it possible to share ground support equipment and personnel, Northrop calculations indicate that Snark can economically be used in single-missile sites.

Economical Distribution

Most economical distribution is estimated to be two missiles per site. This allows some sharing of personnel and ground equipment. Since there are about 120 missiles in a Snark wing, one wing would add 60 high priority aiming points to the task of SUSAC, approximately doubling the number of targets to be wiped out if SAC is to be destroyed. First SAC Snark base at Presque Isle, Maine, now receiving operational missiles, consists of two pads and a shelter containing five missiles mounted upon their roadable launchers.

Big factor in dispersability of Snark is a relatively small requirement for ground support equipment and personnel. Of the total money spent on a Snark force, only 30% or 40% will go for ground support equipment compared to 87% for ballistic missiles. Less than 10 men are needed in the vicinity of the pad to launch Snark. This is the most important factor be-



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Moreover, these compact converters weigh less than 75 per cent of the weight allowed by Military Specifications and require less space than their 8-liter predecessors.

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FOR THE
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THIOKOL

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Solid propellant rocket engines that power many of the latest missiles so vital to America's defense, are mass-produced by Thiokol at the U. S. Army's Longhorn Ordnance Works. Among these are the powerful anti-aircraft Nike Hercules, and the Falcon, and Lacrosse missiles.

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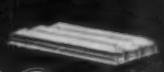
Engineers, scientists – perhaps there's a place for you in Thiokol's expanding organization. Our new projects present challenging problems and the chance for greater responsibility.



Thiokol® CHEMICAL CORPORATION

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cause of high cost and rapid turnover of skilled manpower in USAF. Northrop officials say Snark shows an advantage in dispersability over all contemporary manned bombers and ballistic missiles because high requirements of these systems for GSE and skilled personnel demand concentration of larger numbers so as to share the scarce commodities.

Snark and all its necessary supporting equipment except shelters and pads are transportable by trailer but the missile is not called mobile because of its need for a prepared site. Northrop officials have said that three sites can be constructed for only 20% more money than one. They suggest that if sites outnumbered missile sections, it would be possible to rotate the missiles among the sites, thereby increasing the likelihood of survival and complicating the SUSAC offensive problem.

Many large tracts of military owned land in southern and western U. S. are within range of Soviet target complexes and far from friendly population centers. Sites located in these would be quite secure from enemy intelligence and reconnaissance. Crews could be rotated between the sites and the main bases on an 8-hr. or 24-hr. basis. Roving maintenance crews could travel from site to site as a means of cutting the expenditures upon personnel and equipment. It has been suggested that old Navy aircraft carriers could also be used to provide mobile Snark bases at sea, offering a difficult threat to counter for relatively small cost.

Air Transportability

Air transportability was never a primary requirement for Snark but it can be carried by a Douglas C-124. If USAF considered it necessary, ground support equipment could be redesigned to make possible airlift of one Snark and everything needed to launch it in two of the big transports.

Snark is essentially a conventional high subsonic airplane but because it is a highly specialized one and its mission is a one-way trip, Northrop designers could escape some of the hard compromises that manned airplane designers have to contend with. Maneuverability is guidance-limited and there is little demand for it in Snark's mission. This has enabled engineers to specify small load factors and eliminate horizontal tail surfaces to cut drag. High aspect ratio, 45 deg. swept wing is designed specifically for the cruise regime, as are flight controls. Supersonic final plunge on target is made possible without structural beefup by separating the warhead section from the rest of the airframe for ballistic free fall to target.

Small load factor structure and absence of crew accommodations and safety devices, lack of landing gear, flaps

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and communications equipment results in low fixed weight. Launch weight excluding two 130,000 lb. thrust solid propellant boosters is 50,000 lb. Of this total, airframe, guidance and warhead account for only 24,000 lb. The remainder consists of 21,000 lb. of internal fuel and 5,000 lb. of pylon tanks and external fuel. Large fuel capacity for low gross weight and specialized aerodynamics enable SM-62A to cruise 5,500 naut. mi. at high subsonic speed with a single Pratt & Whitney J57-P-17 engine.

Snark Control

Elevons provide ample control effectiveness for low load factor maneuvers. Trim power requirement and trim drag are minimized by burning fuel from fuselage tanks in controlled sequence to hold center of gravity within tight limits.

There is no rudder and directional trim is unnecessary because of the single engine configuration.

Standard mission profile for SM-62A consists of a climb at military power (10,500 lb. thrust at sea level) to cruise altitude. External fuel tanks are jettisoned when empty. At a predetermined distance from the target, the throttle is advanced to military power and a tendency to exceed commanded Mach number is canceled by a climb to a higher altitude for final run on target. At the proper distance from the target, the stellar-inertial guidance system is disabled and the flight control system commands a zero-G ballistic trajectory ending at the target. When this is established, the finned nose section is separated from the airframe and continues to the target in a supersonic free fall. The remainder of the missile pitches up and is destroyed because of the extreme center of gravity shift caused by the loss of the forward third of the fuselage.

The Snark inertial guidance system represents 1953 state-of-development and was the first of the type to be proven. It went into production in 1955 and was test flown more than 200 times in manned North American B-45 jet bombers. Ground-based Special Purpose Digital Computer, which solves the navigation problem before launch, requires approximately 65% of the cash invested in guidance for a Snark squadron. It is also a large part of the total ground support equipment cost. On-board guidance unit operates by generating error signals proportional to deviations from the programmed flight plan and translating these into commands for appropriate corrective actions.

Like the rest of the on-board systems, the guidance system is built up of plug-in modular units which can

be replaced quickly if found faulty. Ground-based check-out equipment automatically supplies the complete gamut of operational input signals and indicates the module in which any failure occurs to permit swift replacement and minimum hold before launch.

Long Duration

Flight duration of an ordinary intercontinental Snark mission is long—on the order of 10 hr. During this time guidance errors tend to accumulate due to stable platform gyro drift and the 84 min. oscillation about the course line characteristic of unaided inertial navigation systems. Northrop has designed and installed an automatic optical star tracker with a photo tube sensor to shoot a continuous running celestial fix for comparison with that predicted by the ground-based computer. Discrepancies generate error signals which are used to calculate corrections for gyro drift and misalignments in the system. The ground-based computer also teaches the on-board system in which part of the sky to look for the chosen reference stars, thereby minimizing the amounts of searching and identifying required of the airborne equipment. This measure is obviously intended to save weight and cost. The Northrop star tracker can detect the more intense stars in daylight.

To eliminate the 84 min. oscillation, Northrop has installed a lateral velocity damping loop to prevent the missile from overshooting the course line during corrections.

Snark flight control system is a separate subsystem of the guidance equipment. It includes a flight path control to generate steering signals whose value is limited to prevent creation of normal accelerations capable of disorienting the guidance units. Maximum bank angle allowed is 20 deg. It also includes a cruise control to fly the missile at power settings, altitudes, speeds and rates of climb which give maximum range.

Bank Commands

Bank control loop in the flight path control subsystem measures bank angle with respect to a vertical gyro. Its purpose is to augment lateral stability and accept bank commands from the heading control loop. The difference between commanded and measured bank is applied as an elevon differential deflection command. Roll response to this command closes the loop and difference between commanded and measured bank disappears, eliminating elevon deflection signal. A passive network provides damping proportional to the rate of roll.

Heading control loop determines heading error by measuring the angle between the longitudinal axes of the

9 ADVANTAGES OF THE NEW REVERE FLOWMETER SYSTEMS

1. **Modulated 400 cps output—*Proportional to Flow Rate***
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Line Sizes*	1-inch	1½-inch	2-inch	2½-inch	3-inch
Flow Range, GPM**	3-40	10-125	20-250	30-400	50-600
Weight of Transmitter (approx.) lb.	1.1 (SS)	2.0 (SS)	1.4 (AA)	2.0 (AA)	2.7 (AA)
Transmitter End Conn.	Thread	Thread	Flange	Flange	Flange
Material, Standard Transmitter‡	303 Stainless (Mil-S-7720)		61-S Aluminum Alloy (QQA-325)		

Impeller Speed—Rated Flow: 3000 RPM
Pressure Drop at Max. Rated Flow: 2.5 PSI**
Accuracy Over Flow Range: ±1.0%
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Decca Area-Coverage Navigation System

. . . provides all essential requirements for air traffic control:

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guidance system stable platform and the airframe. The difference between actual and commanded angles is used as a heading control signal which generates a roll command to the bank loop. Directional response of the airframe to the bank closes the heading control loop and drives the difference between commanded and actual toward zero.

Pitch control loop acts in much the same manner as bank control loop to handle short period motions and establish the pitch attitude called for by the major longitudinal control loop. Frequency of the first symmetrical fuselage bending mode is 4.5 cps., which is within the pass band of the elevon servo loop. A notch filter in the pitch rate loop is tuned to reject that frequency and prevent elevon-structural coupling.

An impact pressure control loop is designed to control the long period vertical motions of the airframe of which impact pressure is a function and to provide an input for the Mach number control. Difference between measured and commanded impact pressure directs an error signal to the pitch loop. High impact pressure calls forth increased angle of attack, etc.

Snark Speeds

Snark's best cruise is at approximately Mach .93. Missile is held within .01 Mach of the commanded value by Mach control. Mach number is computed from linear measurements of impact and ambient pressures. The Mach computer must also supply an impact pressure command at which the missile will climb during the early part of the flight until it reaches an altitude at which speed is Mach limited rather than impact pressure limited. In the cruise portion of the flight the guidance system makes no effort to correct air speed or Mach number for headwinds or tailwinds of ordinary strength; the system will merely alter time of flight to warhead dump point to compensate for unplanned variations in ground speed.

However, the position error which the guidance system can accept is limited and if unusual winds place the missile too far ahead or behind its flight plan, the system will call for a faster or slower Mach number to get back within the acceptable envelope. Cruise control also establishes the missile altitude by maintaining a constant ratio of gross weight to total pressure. Gross weight change during the flight is obtained from a digital flow meter which transmits a pulse for every gallon of fuel consumed. A totalizer converts the digital count to a signal proportional to total fuel consumed.

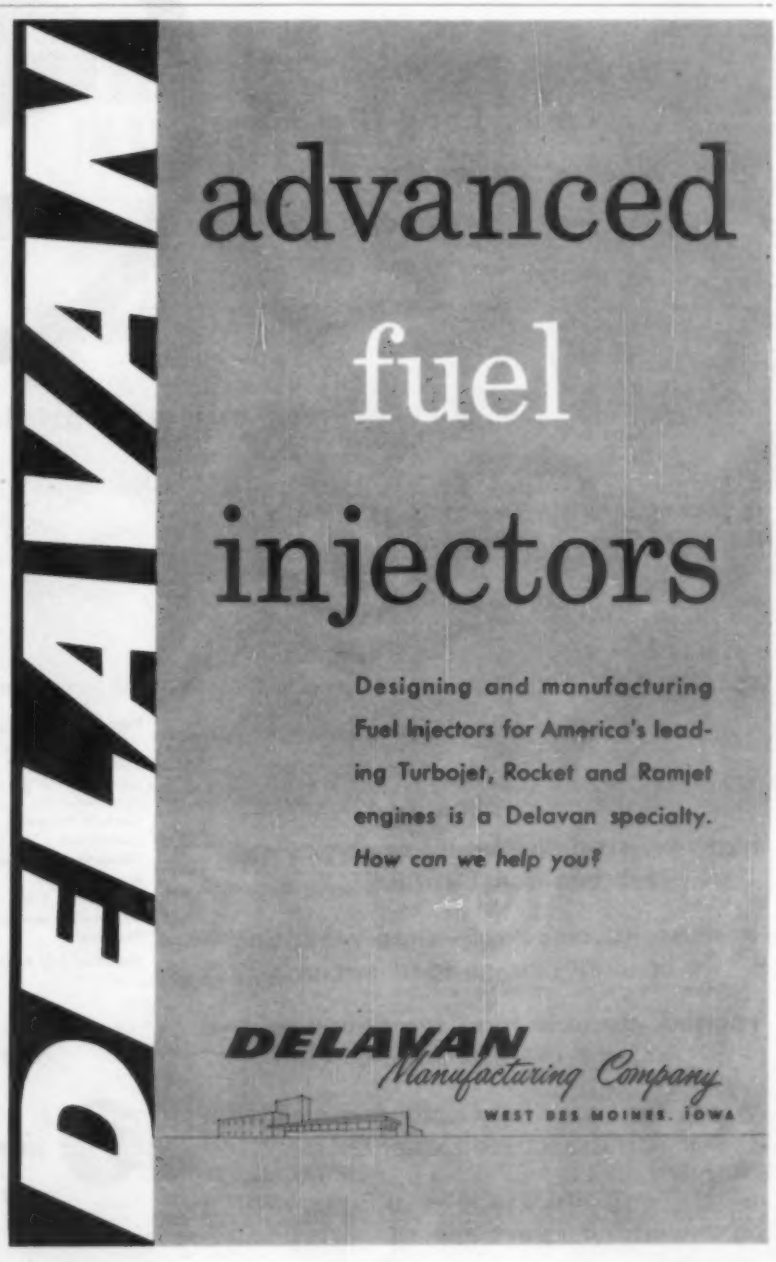
In the first seconds of flight the missile has not enough air speed for the aerodynamic control surfaces to function properly. To provide control forces capable of dealing with cross winds, booster misalignment or assymetrical thrust, Northrop adopted jetavator thrust deflecting rings for the booster rockets similar to those used in Navy's Lockheed Polaris fleet ballistic missile.

Hydraulic Servos

Hydraulic servos position the jetavator rings in response to signals from the flight control system. Hydraulic power is provided for each booster by a one-shot, open-ended system separate from the main missile hydraulic system. It consists of a 1,000 psi., 50 cu. in. piston type accumulator which is pressurized by hot gases tapped from the rocket case, a gas cooling filter, a cylinder actuator, a polarity sensitive valve and a ring position feedback potentiometer. Fluid downstream of the actuator is dumped overboard.

Rocket combustion gases are also used to store power to energize the booster separation device when rocket boost is terminated. Like the elevons, jetavator rings can be deflected differentially for roll control or together for pitch control.

Before launch heading and impact pressure control loops are disabled, the



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extreme small size--may be ganged in minimum space

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longer electrical life than switches twice its size

no dead break--perfect for super sensitive applications

high repeatability--only one moving part besides button

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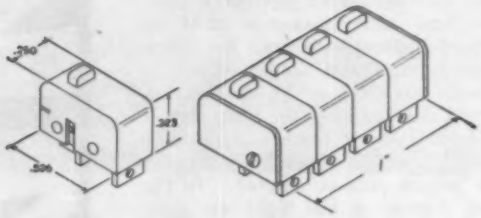
wide range standard actuators available in leafs, toggles, pushbuttons, etc.

super long life model available with limited overtravel



OPERATING CHARACTERISTICS

Base Size	.526" long, .250" wide, .323" high
Weight	1.7 grams (.060 oz.)
Contact	SPDT, fine silver std. (others to order)
Operating Force	approx. .200 grams (7.05 oz.) max.
Pretravel	approx. .010"
Contact Pressure	59 grams (1.76 oz.)
Overtravel	.005" min.
Movement Differential	.003" max.
Release Force	30 grams (1.06 oz.)
Mechanical Life	2,500,000 cycles, approx.
Ambient Temperature	—65° to +250°F. std. (350° to order)
Terminals	solder standard (spade type available)
Electrical Life Rating	6 amps, 125/250 VAC, 30 VDC resistive 3.5 amps, 30 VDC inductive sea level 3.0 amps, 30 VDC inductive 50,000 ft. 2.5 amps, 30 VDC inductive 100,000 ft.

WRITE FOR MORE DETAILS

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TELEPHONE: VAN BUREN 6-3100
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engine is run up to full military power. Launch and climb-out events occur in this sequence:

- X + 0 sec.—Booster ignition. Launch begins.
- X + 4 sec.—Two Boosters separate. Jetavator operation ends.
- X + 15 sec.—Heading control loop is closed and impact pressure loop fade-in begins.
- X + 50 sec.—Impact pressure control loop fade-in completed. Mach computer commands ½ psf. per sec. increase in impact pressure until specified climb impact pressure is reached.
- X + 3 min. — Guidance computation of lateral and longitudinal displacement errors begins. Lateral guidance established by heading commands from guidance computer. Climb at full power and constant impact pressure continues.
- **Mach control** is established when climb impact pressure and commanded Mach numbers coincide.

Structural Design

Structure of SM-62A Snark is designed according to fairly conventional aircraft practices. Fuselage is a 69-ft. long semi-monocoque structure. Its main longitudinal structural members are four extruded aluminum longerons which are tapered at both ends to concentrate greatest strength in the wing root area. Secondary longitudinal members are extruded aluminum stringers spaced on eight-inch centers. Primary lateral fuselage members are frames and bulkheads.

Frames are formed of aluminum sheet and are spaced on one-foot centers. Bulkheads are of one-inch thick aluminum honeycomb. They are located where structural loads, particularly lateral, are heavy and are also used to separate integral fuel cells. Fuselage skin is an important part of the load bearing structure and in most places is made of ⅛-in. aluminum. Flush rivets are used for external fuselage joints and brazier or roundhead rivets are used internally.

Wing Design

Shoulder level mounted Snark wing is swept back 45 deg. on the inboard sections. Outboard leading edge is extended at 12 ft. 8 in. from the centerline. Extension fades back into the wing loft line at the tip causing sweep on outboard section to be about 5 deg. more than inboard section. The wing has no dihedral. Ratio of span to thickness is high—approximately 90—indicating low level of bending load anticipated.

Flexing of the wing in flight led Northrop engineers to split the elevon surfaces to avoid binding and rejoin them through common linkage and a sliding joint. Each elevon has an area of 13 sq. ft. included in the two panels in one semispan. Elevon travel is 20 deg. up and 20 down. Elevon power is the main demand upon the missile's hydraulic system.

Thin wing is afforded some load relief in early part of the flight by the use of wing-mounted external fuel stores, located on pylons about 8 ft. from the fuselage centerline and angled inboard 4½ deg. and downward 3 deg. from the direction of the fuselage centerline.

J57 Thrust Axis

Thrust axis of the tail-mounted J57 turbojet engine is inclined 7½ deg. below the fuselage centerline to permit a short inlet duct. It is suspended in a conventional three-point mount. The engine bay is divided into two compartments.

Area forward of the fire wall is cooled by air bled from the inlet duct, circulated around the engine and exhausted through two exit ducts. Aft bay draws air from the boundary layer through a flush scoop located on each side of the fuselage, into a plenum chamber, around the engine and out through an annular aspirator formed by the engine tailpipe and the fuselage tailcone inner liner.

Lubricating oil is supplied by a

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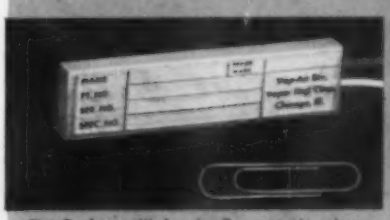

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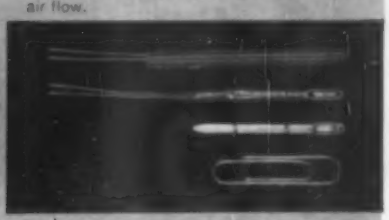

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DEFENSE ELECTRONIC PRODUCTS

CAMDEN, N. J.

Northrop designed tank and system. It circulates through two heat exchangers, an airframe mounted air/oil cooler and an engine mounted fuel/oil cooler. Sundstrand constant speed drive, powered by the engine accessory pad, has a separate oil system with all its components engine-mounted. In turn, a 60 kva. alternator is mounted upon the constant speed drive unit.

The engine is started by an AiResearch pneumatic starter mounted upon the engine.

Fuel System

Fuel system consists of three main fuselage tanks, an auxiliary nose tank and two external droppable pylon tanks. All tanks are pressurized to about 6 psi. relative to ambient by engine compressor bleed vented into the nose tank through a pressure controlling orifice and relief valve. The nose tank is connected to other tanks and pressure is transmitted through the lines. There are electrical booster pumps in the center and aft main tanks.

Ratio of flow from the forward and aft main tanks is controlled by accurate restrictors in the lines to maintain the center of gravity in strict limits. Standpipes and one pressure operated diaphragm valve help control fuel sequencing. A dump line and valve opening above and behind the engine tailpipe exit is installed to get rid of fuel not needed to complete the mission.

Hydrostatic fuel pressure and structural deflection-caused variations in tank volume produced by launch acceleration are controlled and accommodated by carefully sized orifices in the cell-to-cell interconnectors.

Electrical System

Snark electrical system includes a.c. and d.c. umbilical receptacles for ground power. On-board system supplies 60 kva. of three-phase, 115/200v. alternating current at a constant frequency of 400 cps. with a minimum power factor of 0.75 lagging. Alternator is driven by engine-mounted constant speed drive. Steady state voltage is held within plus or minus 1.5% of the specified value and frequency is held constant within plus or minus two cycles per second.

Two d.c. systems are supplied by static type converters operating on the three-phase power of the d.c. system. One provides 200 amp. of 28v. direct current with ripple not over 3% of nominal. The other d.c. system provides special high quality power for critical loads.

It supplies 20 amp. at 28v. with ripple not to exceed 0.25%. All voltage regulators in the electrical system are static type units without electron tubes.

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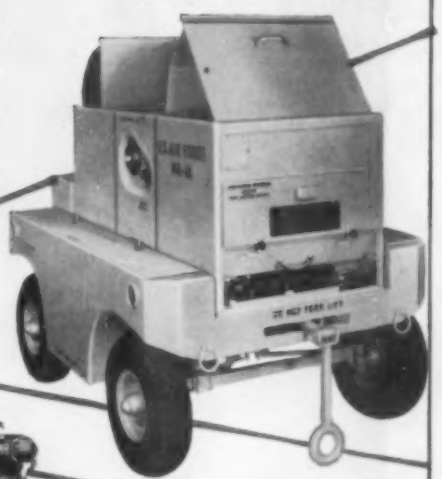
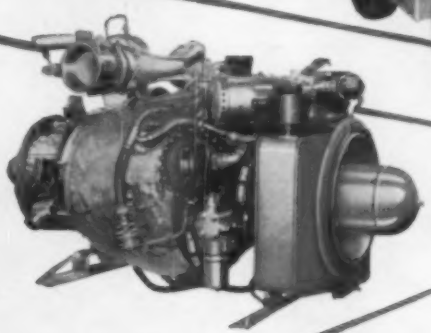


MODEL TC106 (USAF TYPE MA-1A)



MODEL 141 TURBOCOMPRESSOR ENGINE

Typical of the fine results of Continental development is the TC106 trailer-mounted, portable gas turbine compressor unit suitable for starting large jet engines and ground check-out of air conditioning and cabin pressurization systems. The hot discharge air blast can also be used for other purposes such as removal of ice and snow from aircraft surfaces. This advanced model, built around its dependable Model 141 turbocompressor engine, features high performance, excellent mobility, low noise, and a completely automatic control system. This pneumatic compressor package can also be furnished without the trailer for any custom-engineered installation. . . . It is now in volume production at Continental's Production Division, Toledo, Ohio.

CAE turbojet engines—the J69-T-9, the J69-T-2, and the J69-T-19B are in volume production for the Cessna T-37A twin-jet trainer, the Temco TT-1 jet trainer, and the Ryan Q-2A Firebee target drone respectively.

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12700 KERCHEVAL AVENUE, DETROIT 15, MICHIGAN

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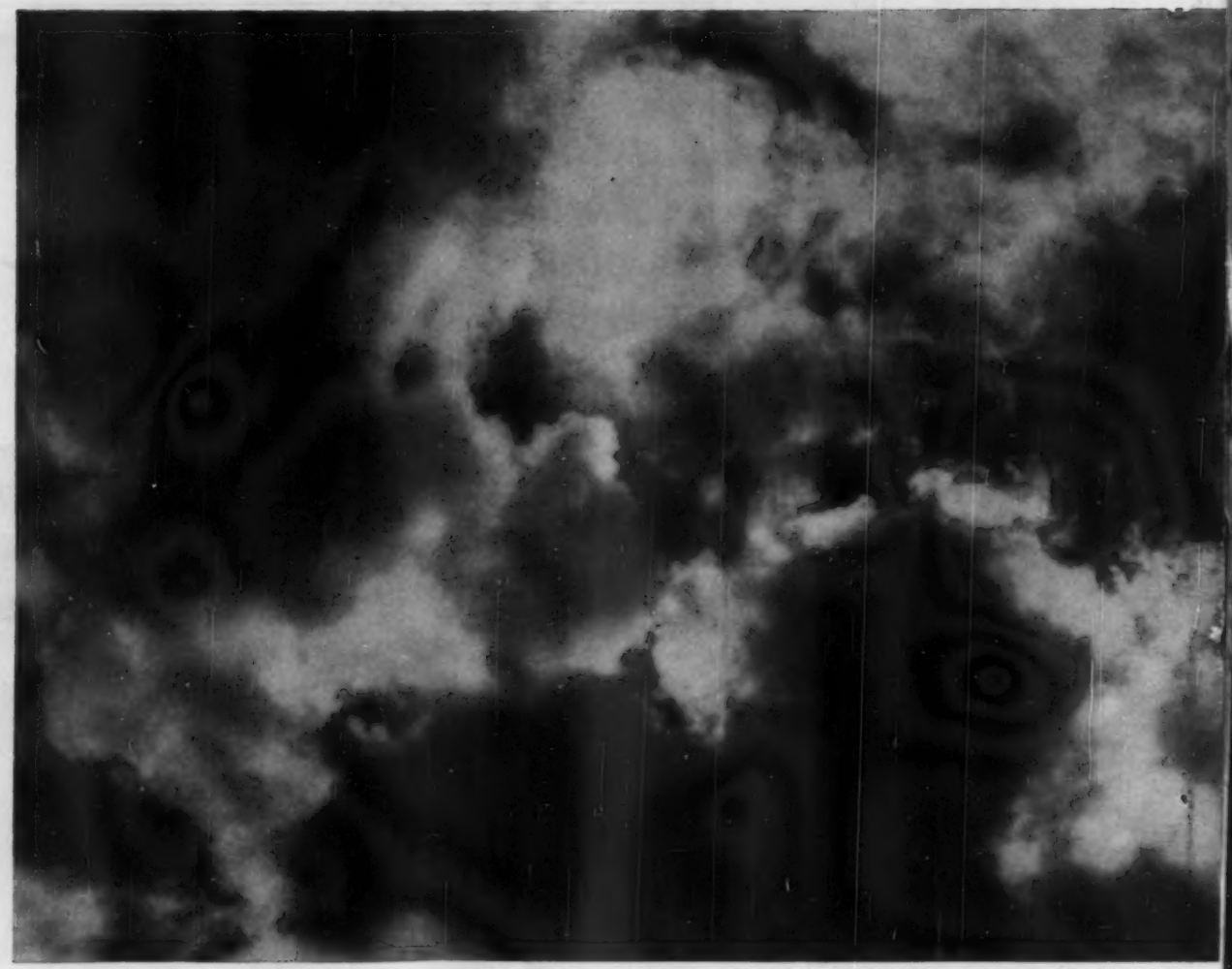

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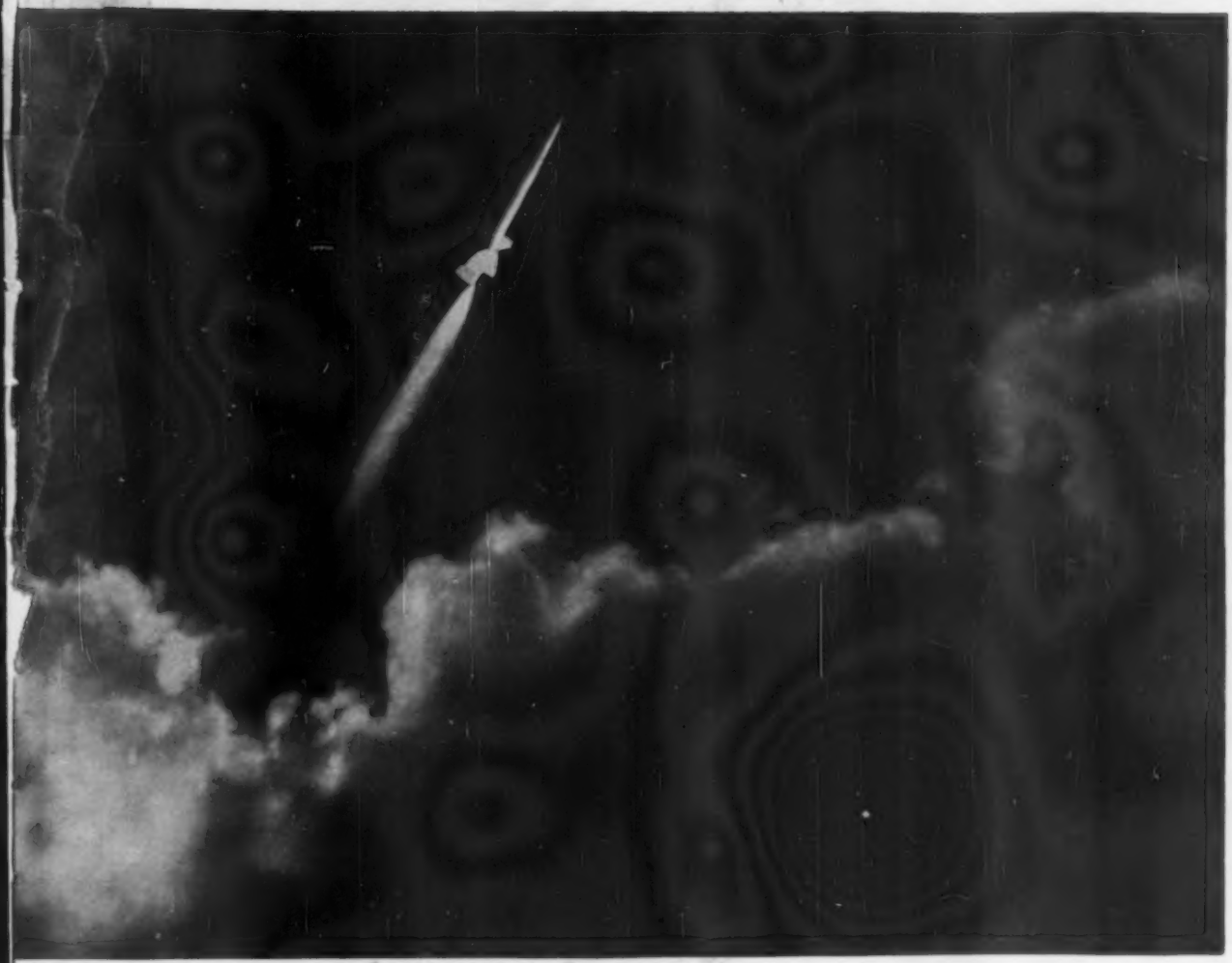
10 Miles Farther

The problem is—how do you get them lighter?



The missile man's rough rule of thumb, "one pound lighter—10 miles farther," cogently points up the importance of miniaturization in increasing missile range and performance.

The successful miniaturization of any given component, however, is limited by a manufacturer's ability to produce the given component uniformly and in quantity.

In the seventeen years Honeywell has been designing and producing airborne control systems, miniaturization techniques have received unremitting attention. Special production and quality control techniques have been developed. Laboratory control methods have been applied to production lines to achieve desired product uniformity and quality.

One recent miniaturization achievement at Honeywell is the famous Gnat Gyro—a complete flight control rate gyro weighing only 3.8 ounces. Another, the new Honeywell Miniature Integrating Gyro (MIG) weighs only 8 ounces. The gyro it replaces weighs 100 ounces—a 92% reduction!

In a completely different area, Honeywell has developed a Transistor Power Converter, the size of a candy bar, and weighing 12.1 ounces. It replaces dynamotors five times as large, weighing 5 pounds—yet it delivers the same performance in transforming one DC voltage to another.

Miniaturization is another area where Honeywell's accomplishments make it a logical choice for further missile systems development and production. If you have a problem in the design of systems or components for aeronautical control, call or write Honeywell, Military Products Group, 2753 Fourth Avenue, South, Minneapolis 8, Minnesota.

Gnat Gyro—flight control rate gyro. wt.: 3.8 ounces

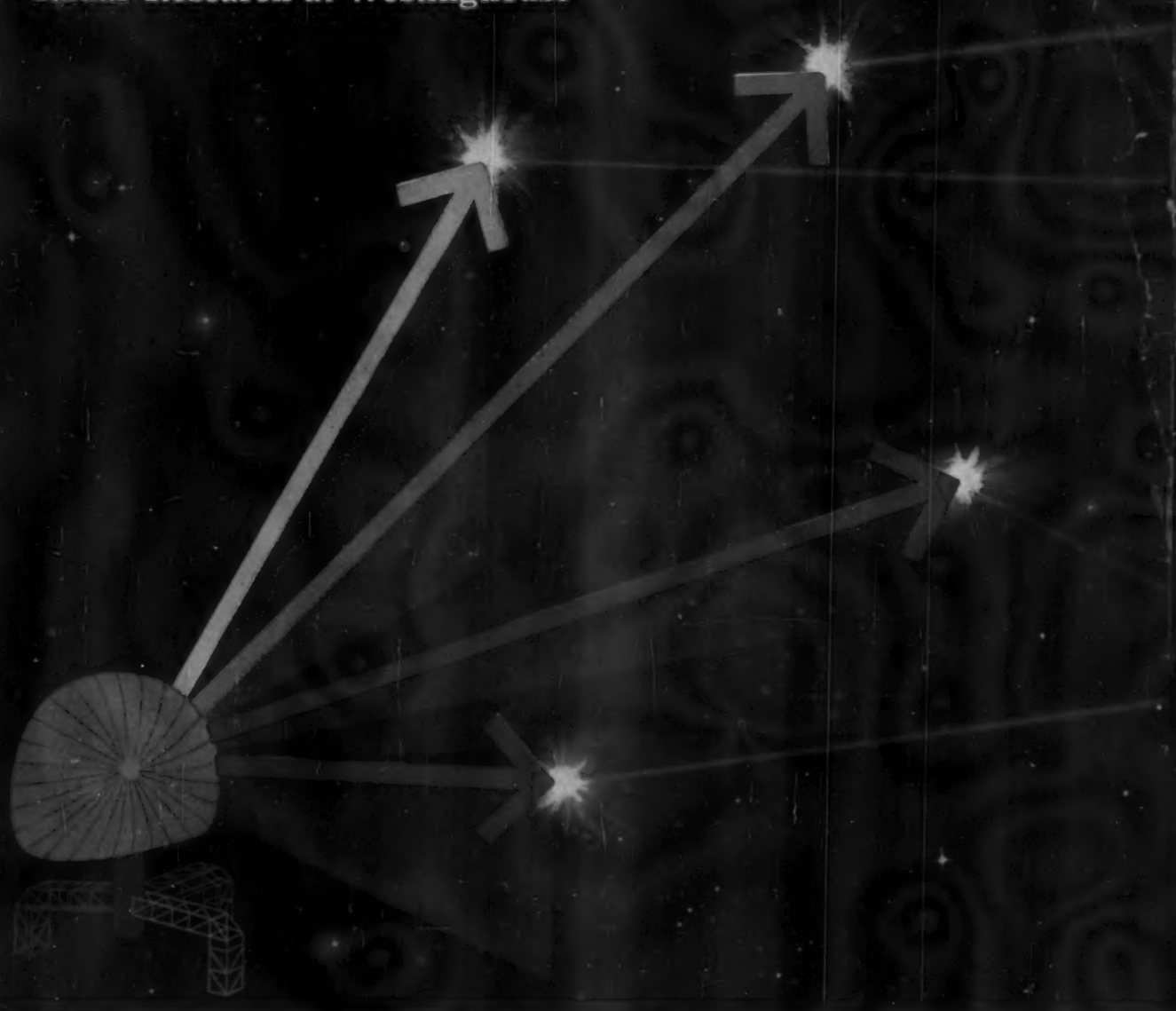
MIG Gyro—Miniature Integrating Gyro. wt.: 8 ounces

"Candy Bar" Converter—Transistorized Power converter. wt.: 12.1 ounces

Honeywell

Military Products Group

Radar Research at Westinghouse



To get a "3D Fix" with a single radar

Gather range, azimuth and height data fast and accurately through one radar—an established fact with new techniques developed at Westinghouse Electronics Division.

Developments like this go on constantly at the Electronics Division. There the design, development and production of vital military systems and subsystems help to keep the free world ahead.

Westinghouse Electronics Div., P. O. Box 1897, Baltimore 3, Md.

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Yet there have been no cuts in the constantly expanding school program, hospitals or other essential public services. It exemplifies a continuing awareness of the need for a favorable tax structure and our effort to make Jacksonville a better place to work and live.

Jacksonville also enjoys the general benefits of Florida's excellent tax climate... no state income tax, no state ad valorem tax, no direct state inheritance tax.

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New Loading Reduces Missile Firing Time

Pottstown, Pa.—Minneapolis-Honeywell's Missile Equipment Division and A. D. Little, Inc., have developed a propellant-loading system that, the two companies claim, will shorten countdown time in firing liquid fuel missiles. The system, produced primarily for the Atlas intercontinental ballistic missile, provides automatic transfer from launching-base storage tanks of propellants with which the vehicles are charged.

Missile Equipment Division developed the control system under contract to the A. D. Little Co., of Cambridge, Mass., which is in turn under contract to the Air Force Ballistic Missile Division. Major components of propellant-loading systems now being installed at operational launching sites are being supplied by Minneapolis-Honeywell.

Nike Hercules Site

Douglas Nike Hercules surface-to-air missiles are poised on Army launch ramp. The 5,000 lb. missile hit a target flying at 650 kt., 50,000 ft. altitude and 50 mi. range (AW July 7, p. 36).

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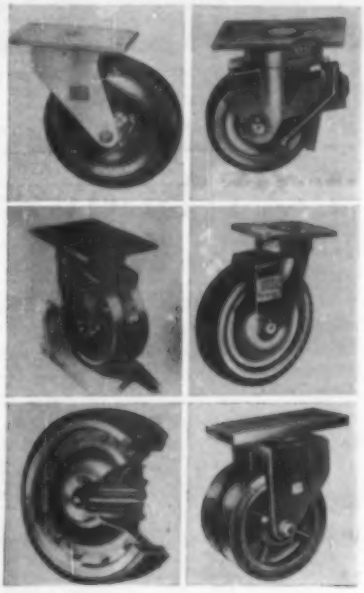

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F-27's high, full cantilever wing allows use of 12-ft. diameter Rotol propellers. Span is 95 ft. 2 in.; wing area is 754 sq. ft.

Aviation Week Pilot Report:

F-27 Shows Power, Short Field Capability

By Robert I. Stanfield

Hagerstown, Md.—Power, flight characteristics and short-field capabilities of Fairchild's twin-turboprop F-27, coupled with its pressurization and air conditioning, make it a well-suited and economical replacement for the slow, outdated aircraft long in use with local service and feeder airlines, and industry.

Tricycle-geared F-27, which seats up to 44 passengers, is built and produced in the United States by Fairchild under a licensing agreement with the Royal Netherlands Aircraft Factories Fokker, the designer. The first Fairchild production aircraft flew April 15. On July 30, the F-27 became the first American-built turboprop to be certificated by the Civil Aeronautics Administration.

F-27 features evidenced during a flight evaluation by AVIATION WEEK included:

• **Turboprop power.** Rolls-Royce Dart R.Da. 6/511 engines, with overhaul life now at 1,800 hr., generate 1,600 shp. and 14,500 rpm. at takeoff. Gear ratio is 0.86. Dart R.Da. 7/528, now being flight-tested at Hagerstown, will produce 1,910 shp. at takeoff and 15,000 rpm. Gear ratio is .093. Maximum speed of the F-27 at 20,000-ft. with 13,800 rpm. is specified at between 276-300 mph., depending on engine installation. At 10,000 ft., pulling this power with Dart 511s, true air speed (TAS) was 233 kt. (268 mph.).

• **High wing.** Set high on the fuselage, the full cantilever wing permits use of 12-ft. diameter, four-bladed, hydraulic constant-speed Rotol propellers for improved takeoff and climb performance. The high wing also enhances passenger visibility and affords a level cabin area that sits only 43 in. above ground, adding to the efficiency of passenger and ground handling operations.

• **Short-field capabilities.** High aspect ratio wing aids in short takeoffs and landings. There aren't many airports that won't be able to accommodate the F-27. At a weight of 32,500 lb., into a wind of 8 kt., the aircraft was flown off in 1,200 ft. with 15 deg. flaps. No brakes were used following normal approach and landing, at Douglas DC-3 pattern speeds, and the F-27 was easily turned off the 3,500 ft. runway.

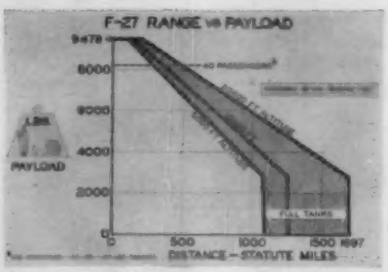
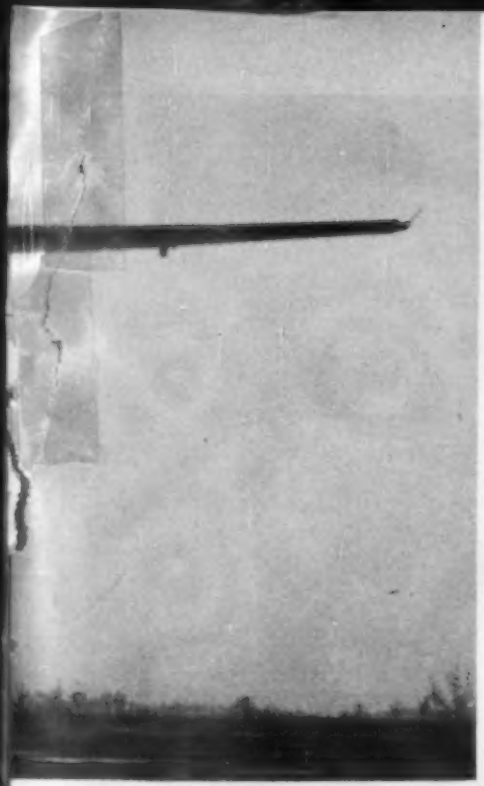


CHART above is based on R.Da. 6/511 engines and internal fuel of 1,320 gal. With fuel capacity boosted to 1,660 gal., F-27's range increases to 2,250 s.m.

• **Single-engine performance.** Control was excellent with one engine feathered, with no excessive yaw apparent. The F-27 was held straight with a light amount of aileron pressure, followed by only 1.5 deg. of rudder trim. Holding normal rated power, with left engine feathered, the F-27 indicated 150 kt. at 10,000 ft. The airplane has been climbed at 415 fpm. with one engine shut down.

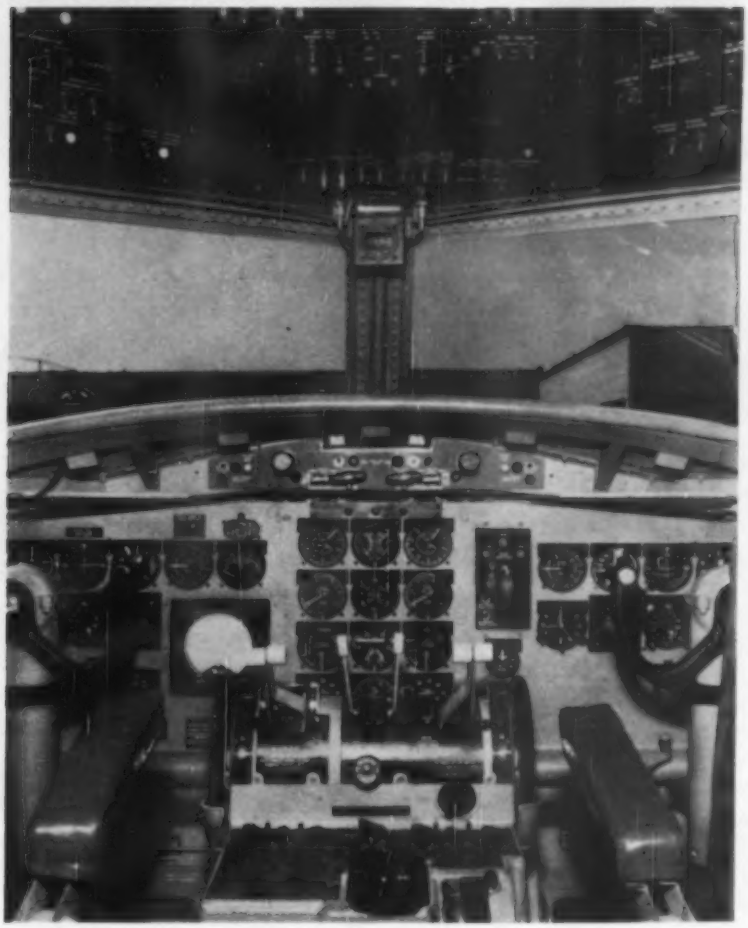
• **Flight comfort.** Pressurization maintains an 8,000 ft. cabin altitude at 20,000 ft. flight altitude. Sea level conditions can be maintained at 9,000 ft. During climb to 10,000 ft., the rate of change was 500 fpm. Air conditioning held cabin temperature to a comfortable limit. The airplane was fairly quiet, but additional soundproofing is aimed at reducing compressor noise.

Aircraft flown during the evaluation was N2700R, the first F-27 (with Dart 511 engines) earmarked for Piedmont



Height is 27 ft. 6 in.

in Evaluation



SIMPLIFIED controls and instrumentation of F-27 (right). Note panel-mounted gear lever, to right of center, and Bendix RDR-1D radar screen to left. Current rate of production (below) is five a month.

Margin for Error . . . *None!*

You swing into your final approach. At precisely the right instant the Landing Signal Officer flags you to cut your power—and you're aboard! ☆ Such skill and precision is indicative of that which is required today in *every* phase of the aircraft industry. The bearings in modern jet turbines, for instance, must be held to accurate tolerances measured in millionths of an inch. That's why the leading jet turbine manufacturers specify Bower aircraft bearings first. Their exceptional high quality and unerring precision allow Bower bearings to stand unbelievable turbine speeds and temperatures—that match the supersonic speeds of today's jet aircraft—*with a minimum of lubrication.* ☆ Whatever *you* produce, if it uses bearings, specify Bower! Choose from a complete line of tapered, straight and journal roller bearings for every field of transportation and industry.

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Airlines. Along with the AVIATION WEEK pilot was Ed Hopwood, Fairchild engineering test pilot. Normal crew complement on the F-27 would consist of two pilots, plus a stewardess for airline operation. Gross weight at takeoff was about 32,500 lb.

Airplane was entered through the cabin door, which is hinged at two points at the bottom and opens outward. The cabin is smartly designed. Fairchild offers three standard airline interiors, seating 36, 40 or 44 passengers. Standard executive version is designed to accommodate 16. Soundproofing is via two layers of glass fiber batting; four layers are installed at the wing area and propeller centerline areas.

Twenty elliptical windows, 10 on each side, are provided for passengers. Construction is double-pane Plexiglas except for windows in the propeller plane area, which are similar to the crew compartment windows. These contain vinyl sheet, sandwiched between two highly tempered panes of plate glass, for propeller anti-ice.

Cockpit of the F-27 is comfortable and efficiently designed. Engine gages, centered on the instrument panel, include a tachometer, oil temperature gage, jet pipe temperature gage, oil pressure, torquemeter, fuel pressure and fuel quantity indicators, plus warning lights. Flight instruments are mounted directly in front of pilot and copilot. A Bendix RDR-1D radar screen sits just left of center. Feathering panel sits directly above the main instrument panel.

The engine control quadrant contains high pressure fuel valve lever controls, rpm. levers and elevator trim wheels. Aft portion of the quadrant seats radio controls and controls for flaps, rudder and aileron trim and fuel cross-feed valve. Three-section overhead control panel, above the pedestal, mounts switches, voltmeters, loadmeters and warning lights. Circuit breakers are behind the copilot's seat.

The pilot's console contains controls for nose wheel steering, park brake and emergency air brake. The copilot's console contains a pneumatic de-icer panel, pressurization controls, pressure indicators, and a crew compartment air conditioning control switch. Gust-lock handle is located to the left of the pilot's seat, near floor level.

Two paralleled, 24-v. 20 amp.-hr. nickel-cadmium Sonotone batteries installed on the left side in the nose section supply power for engine starting or during electrical emergencies.

Starting procedures are automatic and uncomplicated. With the battery on, bus switch off, prop emergency switch

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both indicator and amplifier in one housing ... only 2.2 inches long

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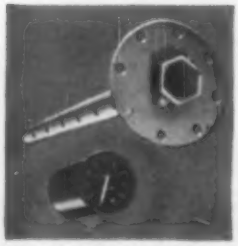
Simmonds packages three types of PACITRON Fuel Gage systems, custom-built for every requirement: the new 2-unit transistorized gage, the well-known 2-unit vacuum tube gage, and the lightweight 3-unit system. Along with dependable fuel measurement, *ALL* PACITRON systems provide important fuel *management* functions such as Center of Gravity Control, Level Switching, Totalization, Telemetering and Load Limit Control. All systems meet MIL specs.

Complete information on all the above systems is available on request.



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A Down-To-Earth Look At Today's Missile Picture

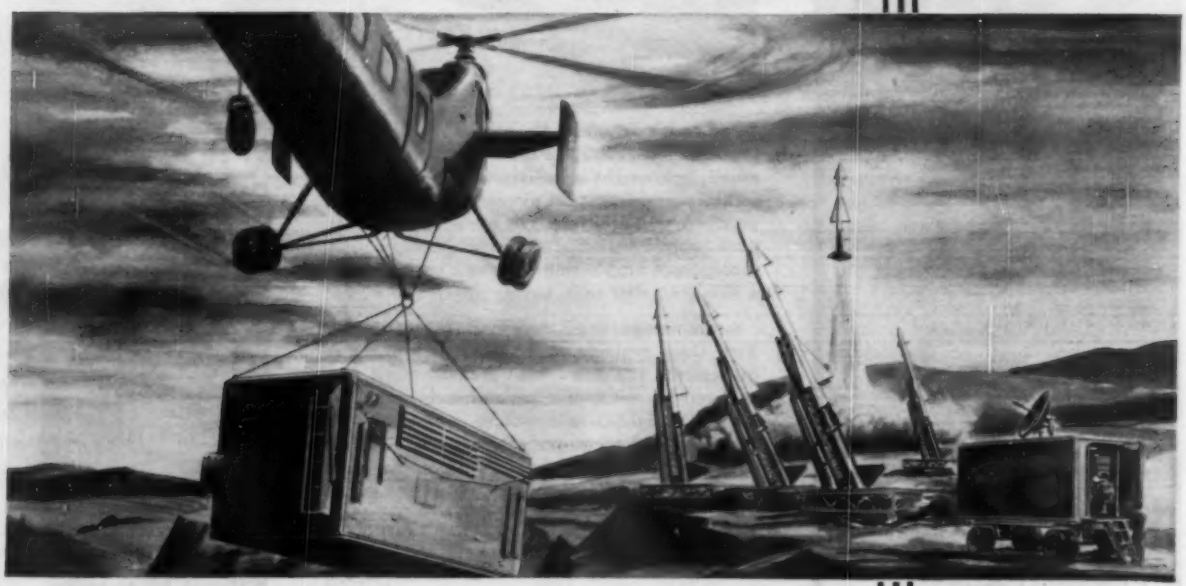
NOW that operational missiles are becoming a reality and production in quantity a fact, it has been necessary to look at the tremendous storage, transportation, and ground handling problems from a practical, dollar-conscious, down-to-earth point of view.

Each day more assignments for the development and manufacture of *practical, economical* handling units are being brought to Fruehauf, long known for its expert experience and education in commercial transportation areas. And Fruehauf has successfully responded in filling the need for the design and manufacture—at lowest possible cost—of dependable, versatile, multi-purpose ground handling units in quantity —on practically a commercial level. This is the business like approach to the missiles picture, but it must be made, and no one is better equipped and staffed than Fruehauf to do so.

Not only in relation to missiles but for *many* military ground-handling needs, Fruehauf research, engineering, and manufacturing knowledge is being utilized profitably by the services and other contractors. Here are a few of the widely varied projects with which Fruehauf has been associated in a development or manufacturing capacity:

- **Ground handling equipment for 17 missile types**
- **Missile launchers**
- **Guidance shelters for missiles**
- **Shelters for electronic and radar equipment**
- **Specialized tank-trailers for fuels**
- **Power haul vans**
- **Vans for testing equipment**
- **Standardized refrigerator vans and other mobile materials containers**
- **Formal detail specification drawings in quantity**
- **Rough terrain trailers**
- **A total of over 400 different types of military vehicles**

You can put confidence in Fruehauf's long experience and extensive facilities in meeting any ground handling problem concerning missiles, guidance shelters, weapons systems, or materials supply.



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F-27 with R.Da.6 Engines
Summary of Operating Costs ($) per Flight

Nautical Miles	Selected Stage Distances 130	260	521	868	1,303	1,737
Operating Costs						
1,000 Hr. per Year						
Crew Costs	17.20	31.56	57.64	92.44	136.40	181.20
Insurance	13.98	25.64	46.83	75.11	110.83	147.23
Fuel and Oil	26.52	42.33	76.50	122.06	180.54	212.16
Maintenance	17.09	31.35	57.26	91.82	135.49	179.99
Depreciation	59.89	109.89	200.71	321.88	474.96	630.95
Total costs per Trip	134.68	240.77	438.94	703.31	1,038.22	1,351.53
Per Naut. Mi. (¢)	103.36	92.43	84.23	80.99	79.70	77.82
Per Hour ($)	187.06	182.40	182.89	182.68	182.79	179.01
Per Year ($)	187,060.00	182.400.00	182,890.00	182,680.00	182,790.00	179,010.00
700 Hr. per Year						
Crew Costs	24.57	45.09	82.35	132.07	194.88	258.89
Insurance	19.97	36.64	66.91	107.31	158.34	210.34
Fuel and Oil	26.52	42.33	76.50	122.06	180.54	212.16
Maintenance	17.09	31.35	57.26	91.82	135.49	179.99
Depreciation	85.56	157.00	286.73	459.85	678.53	901.39
Total Costs per Trip	173.71	312.41	569.75	913.11	1,347.78	1,762.77
Per Naut. Mi. (¢)	133.32	119.93	109.34	105.15	103.47	101.50
Per Hour ($)	241.26	236.67	237.40	237.17	237.29	233.48
Per Year ($)	168,882.00	165,669.00	166,180.00	166,019.00	166,103.00	163,436.00
500 Hr. per Year						
Crew Costs	34.40	63.12	115.28	184.88	272.80	362.40
Insurance	27.95	51.29	93.67	150.22	221.65	294.45
Fuel and Oil	26.52	42.33	76.50	122.06	180.54	212.16
Maintenance	17.09	31.35	57.26	91.82	135.49	179.99
Depreciation	119.78	219.79	401.42	643.77	949.91	1,261.91
Total Costs per Trip	225.74	407.88	744.13	1,192.75	1,760.39	2,310.91
Per Naut. Mi. (¢)	173.25	156.58	142.80	137.35	135.14	133.06
Per Hour ($)	313.53	309.00	310.05	309.81	309.93	306.08
Per Year ($)	156,765.00	154,500.00	155,025.00	154,905.00	154,965.00	153,040.00

(Compiled by Ray and Ray airline consultants, Wash., D. C.)

normal and engine synchronization switch off, the prop is placed in ground fine pitch. With power levers at idle and fuel trimmer switches at decrease, the pilot hits the start selector switch. Prior to starting the high pressure fuel valve lever is opened and the starter button is pressed.

Automatic Injection

Engines idled at 7,000 rpm., with jet pipe temperature 425C. The fuel datum position indicator on the overhead panel was used to check water-methanol injection. Mixture is automatically injected when operating at high power settings in high ambient temperatures. Fuel flow is trimmed to maintain the engine temperature within acceptable limits. At sea level, with the temperature above 15C, engine power is restored to a value obtained under ISA conditions.

Above sea level, power is restored to a value which is obtained at that particular altitude under ISA conditions.

Each engine is served by an independent fuel system with cross-flow system available for supplying either engine from the opposite side. An integral tank of 660 gal. is located in each outer wing, with gravity feed to the collector tank in each nacelle. Optional equipment includes installation of a bladder tank holding 470 gal. in each center wing.

The bladder cells feed into the respective collector tanks through shut-off valves, so that either inboard or outboard tanks may be selected to feed each engine, or the opposite engine in event

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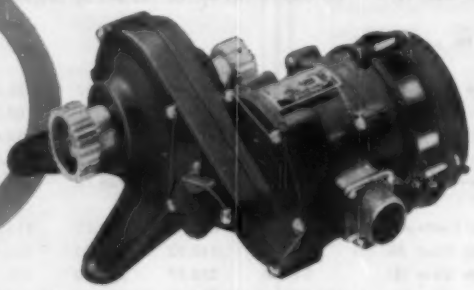
Emergency flap drive on Boeing 707 Stratoliner is provided by Airborne Model R1624-1 special-design rotary actuators. Units are permanently coupled to flap linkage, provide electro mechanical drive in event of hydraulic failure. Output shafts are driven whenever hydraulic system operates, but because of special inertial clutch, rotors do not turn unless energized.

AIRBORNE LARGE SPECIAL ACTUATOR SOLVES EMERGENCY FLAP DRIVE REQUIREMENTS ON BOEING 707



Specifications: Motor: 200/115 v a-c, 400 cycles, 3-phase, reversible. Speed at rated torque (450 in-lb): 85 rpm±10 rpm. Duty cycle 3 min. on, 27 min. off. Operating range: 102-124 v (line to neutral); 380-420 cps; −65 to +160°F; 0-50,000 ft. Weight 12 lbs.

In addition to offering an extensive line of modular-type electromechanical actuators, Airborne can also meet your requirements for large special designs—linear or rotary. Typical of these special Airborne actuators is Model R1624-1, used on Boeing's new 707 Stratoliner to operate the flaps in the event hydraulic power is lost. At the right are some of the more difficult engineering problems that were presented by this specialized application, along with Airborne's solutions to them.

PROBLEM	SOLUTION
Rotor to be disconnected from output gear stages except when motor is energized in either direction.	Inertial clutch—consisting of small weights in a cage—incorporated between motor and gear train. Makes positive contact with intermediate drive gear only when rotor shaft turns.
Starting torque to be 800 in-lb minimum, with pullout torque of 900 in-lb (±100 in-lb) at 50% motor slip (±10%) under all voltage, frequency and environmental conditions.	Special lightweight motor developed by Airborne to meet these exacting requirements. Rated .9 hp at 10,300 rpm, drawing 2.5 amp maximum.
In event of a jam in actuator transmission or rotor, unit to be fail-safe by permitting rotation of output shaft by torque of 1000-1300 in-lb. Once started, rotation to be maintained by torque not exceeding 100 in-lb.	Special ball-detent, torque-limiting clutch incorporated on output shaft.

Contact us for recommendations on your special actuator requirements . . . or for information on Airborne's standard line of modular design actuators.

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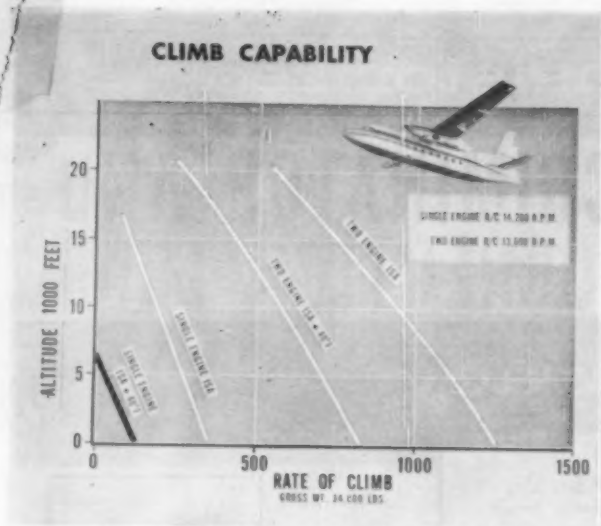

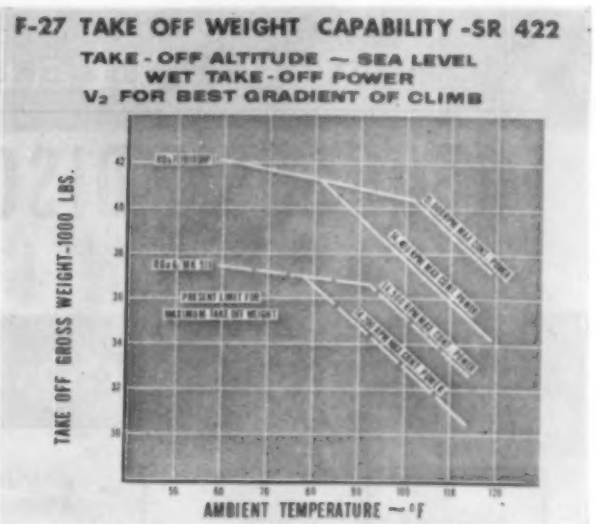
F-27 TAKE OFF WEIGHT CAPABILITY -SR 422
TAKE - OFF ALTITUDE — SEA LEVEL
WET TAKE - OFF POWER
V2 FOR BEST GRADIENT OF CLIMB
TAKE OFF GROSS WEIGHT-1000 LBS.
AMBIENT TEMPERATURE — °F

CLIMB and takeoff capabilities of F-27. With R.Da. 7/528 engines, pulling 14,400 rpm. at sea level, rate of climb is 1,700 fpm.

of cross-feed operation. The integral tanks are formed by the spar box of the outer wing panel. They are sealed with rubber cement protected by a coating of fuel-resistant material. Each tank incorporates baffles, formed by wing rib diaphragms, to prevent excessive fuel sloshing.

Trapped fuel in the standard system (without pressure refueling) weighs about 21 lb.

For taxiing, rpm. was increased up to 10,400 to move the blades out of flat pitch and the airplane was wheeled down the strip. Steering with the nosewheel was smooth, though excessive load and forward center of gravity, combined with low speed, reportedly does not produce the better results obtained with lighter weights. Nose gear is steerable through an arc 60 deg. to the left and right of center, free swiveling through 360 deg.

Visibility during taxi and all phases of flight was excellent. Three-ply windows are located adjacent to the pilot and copilot.

Forward windshield is of laminated electrically-conducive coated NESA glass, for de-icing purposes, and can withstand the impact of a four-pound bird at cruising speed at sea level.

Boots take care of wing ice. Propellers, engine air intakes, oil cooler intakes and accessory air inlets are also electrically heated to effect de-icing.

Sea level pressure takeoff was 30.08 in. Wind was from the southwest at 8-10 kt. and outside air temperature was 29C. Field elevation was 704 ft. Takeoff was to the west, on a 5,200 ft. runway.

After checking temperature against the fuel datum indicator, the airplane was ready to roll. Fifteen degrees of flaps were dropped and the F-27 accelerated quickly, effective rudder control taking hold about 60 kt. The airplane flew itself off in about 1,200 ft. at 75 kt.

The gear control handle on the instrument panel is closer to the copilot than the pilot; however, either can reach it without any effort and, in this instance, the gear was retracted by the left seat driver. Retraction takes about 4 sec.

V2 (takeoff safety speed) of 89 kt. was reached almost concurrently with fly-off. At 100 kt. the flaps were raised.

F-27 Specifications

Wing span	95 ft. 2 in.
Length	77 ft. 2 in.
Height	27 ft. 6 in.
Propeller to fuselage	1 ft. 8.5 in.
Propeller to ground	2 ft. 10 in.
Wing chord, at root	11 ft. 4.8 in.
Wing chord, at tip	4 ft. 7.2 in.
Total wing area	754 sq. ft.
Total aileron area	37.6 sq. ft.
Total flap area	590 sq. ft.
Horizontal stabilizer area	172 sq. ft.
Vertical fin area	153 sq. ft.
Wing loading	47.3 lb./sq. ft.
Power loading	10.4 lb./tehp.
Aspect ratio	12
Empty weight (40 passenger configuration)	21,645 lb.
Zero fuel weight	32,400 lb.
Maximum takeoff weight	35,700 lb.
Maximum landing weight	34,000 lb.
Pressurization	4.16 psi.
Engines:	
Two Rolls-Royce R.Da. 6 Darts, each rated	1,720 tehp.
or two Rolls-Royce R.Da. 7 Darts, each rated	1,990 tehp.
Gear ratio, R.Da. 6 (4-bladed, 12-ft. Rotol propellers)	.086
Gear ratio, R.Da. 7 (4-bladed, 11.5 ft. Rotol propellers)	.093

Climbout, at 13,800 rpm., with the airplane indicating 120 kt., produced a 1,400 fpm. rate of ascent.

At 3,000 ft. the F-27 was indicating 115 kt. and climbing at 1,300 fpm. Jet pipe temperature for both engines ran between 520C and 540C. Torque pressure was 260 lb. left, 280 lb. right. Fuel flow was 820 lb./hr. Climb angle was not steep enough to hurt forward visibility. Trimmed up, lateral control was excellent and the airplane flew smoothly all by itself.

There was little strain in holding a normal conversation during climb. The airplane was quite comfortable and in 7.5 min. we had reached 10,000 ft. and leveled off. Cabin pressure at this altitude was 1,000 ft. We held the same power setting of 13,800 rpm. Jet pipe tail temperature was 500C. With outside air temperature 10C and indicating 195 kt., our true air speed was 233 kt. Fuel flow was 750 lb./hr.

The airplane responded smoothly to varied degrees of bank. Flying characteristics are good. The F-27's normal operating limit speed is 227 kt. calibrated air speed (CAS); the never exceed speed is 259 kt. CAS, and minimum control speed is 78 kt. CAS.

Before feathering the left engine we took our feet off the rudder pedals and pulled the left prop to idle, where it windmilled. There was practically no yaw, and with a small amount of aileron control the F-27 was held on a straight heading. The left engine was then feathered—prop blades turned to a high pitch setting of 83 deg.—and the airplane trimmed up neatly with only 1.5 deg. of rudder trim.

Automatic feathering occurs if an engine fails at a power setting above 11,500 rpm. and the opposite engine is not already feathered. Feathering also can be accomplished manually. Should one

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engine be feathered automatically or manually, a cam-operated switch disarms the automatic feathering circuit of the opposite engine.

Power was not increased during single engine operation, and with the left engine feathered the airspeed indicated 150 kt. Control remained good during tight and medium turns into and away from the dead engine. Slotted-type ailerons, with a span of 27 ft., can travel 33 deg. up, 22 deg. down. Rudder travel is 20 deg. left and right. Elevator travel is 25 deg. up, 22 deg. down.

Bringing back the dead engine, power on both was reduced to 10,400 rpm. and gear and 25 deg. of flaps were lowered. Maximum airspeed for operation of the gear is 170 kt.; that for 25 deg. of flaps is 140 kt.; full flaps (40 deg.), 126 kt. It's no secret once the gear is actuated; extension takes about 15 sec.

The F-27 was stalled straight ahead in landing configuration. The Safe Flight stall warning indicator provided both visual and stick-shake warning at about 70 kt. indicated—about 8 kt. before the break. Some aileron control was necessary, but response was very satisfactory.

Stall Warning System

The stall warning system consists of a vane-type transducer installed in the leading edge of the left wing, a signal summing unit on the radio equipment rack, a stick shaker on the pilot's control column, and a speed control indicator located on the pilot's instrument panel glare shield.

Local flow direction and dynamic pressure acting on the transducer vane cause a corresponding displacement of the vane which is indicative of the angle of attack of the wing. Vane displacement causes an electric signal to be directed to the signal summing unit. Output of the unit is used to drive the needle of the speed control indicator and to activate the control column shaker when a stall is imminent.

Approach to stall—usually 8-10 kt. preceding the break—is indicated by deflection of the stall warning indicator needle to the left, plus shaking of the wheel. An "off" flag appears when the system is not energized or malfunction occurs.

Good flying characteristics were evident during all flight regimes. Controls were quite effective at low speeds—during a simulated instrument landing system (ILS) approach at 100 kt., and during varied turns at a 300 fpm. rate of descent—holding 11,500 rpm.—at 90 kt.

A simulated go-around was made in landing configuration with 40 deg. of flaps. With airspeed at 90-kt., the gear was raised and the flaps partially retracted to 15 deg. As power was applied the F-27 quickly accelerated to 110 kt.

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Whatever your high pressure gauge problems may be, why not let RMC engineering skill provide the answers. Write to either plant, or contact one of the RMC representatives listed below:

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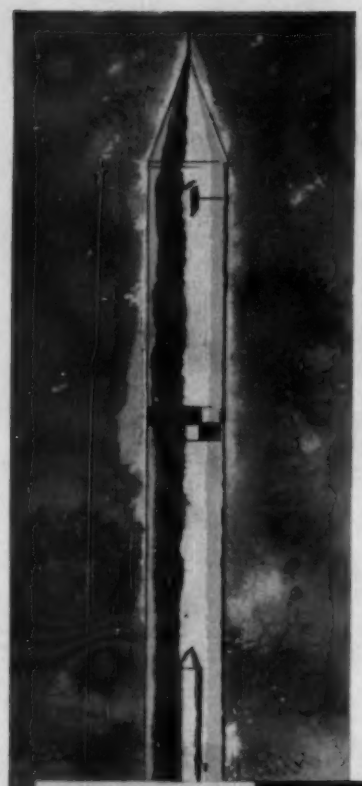

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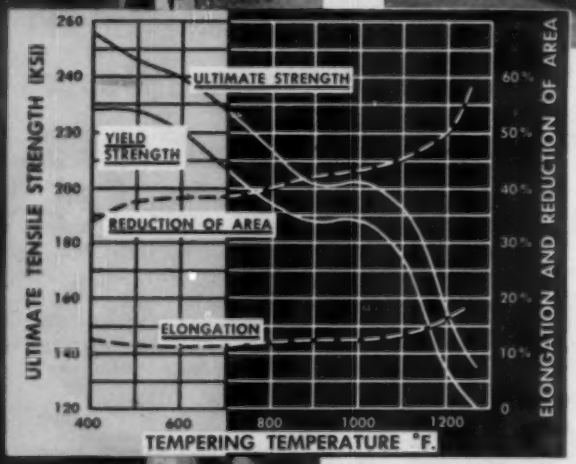

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indicated, and the flaps were completely retracted. The altitude gain was immediate.

With engines pulling 10,500 rpm. and the airplane indicating 190 kt., a descent was made at 2,000 fpm. Cabin pressure change was at the rate of 200 fpm. Jet pipe temperature during the descent was 420 deg.; torque pressure was 80 lb.

A pneumatic power system provides air pressure for operation of the landing gear, wheel brakes, nose wheel steering, retraction of the entrance door and the propeller brakes. System consists of two engine-driven compressors, three compressed air reservoir bottles and purifying, regulating and indicating components.

While system pressure is maintained at 3,300 psi. by the compressors, excessive pressure of 3,500 psi. is relieved through either of two system relief valves installed on the pneumatic panel.

Emergency gear extension is via a manually operated handle behind the pilot's seat. Positioning of the handle permits emergency pneumatic system air, reduced to 100 psi. pressure, to be directed through separate lines to shuttle valves located on each gear and uplock actuating cylinder, extending the gear into the down and locked position.

Flap Installation

An inboard and outboard single-slotted type flap is installed on the trailing edge of each wing panel. Actuation is keyed to an electrical motor. Full extension at 123 kt. CAS requires about 11.5 sec. Retraction, at 95-100 kt. CAS takes about 10.5 sec. Automatic shutoff is provided to prevent unequal extension.

Flaps may be manually operated by a handcrank. Each degree of movement will require 6.5 turns—a hefty 270 complete turns will fully extend the flaps to the 40 deg. position.

Landing was made to the southwest, on Fairchild's 3,500 ft. runway. Wind was from the south-southwest at 13 kt. Pattern speeds were on a par with the DC-3. Power was held to 65%, and "water" was adjusted in the event of a go-around. The gear was dropped at 150 kt., followed by 25 deg. flaps.

Airspeed on downwind was 100 kt. Turning onto base, the F-27 was slowed to 95 kt. and began a 700-fpm. rate of descent. Airspeed was held until the turn onto the final approach, then reduced to 85 kt. Flareout was at 80 kt., touchdown at 70.

The F-27 could have been stopped within 1,000 ft. with little effort, but no brake pressure was applied during roll. Flaps were raised, props pulled to flat pitch, and the airplane decelerated smoothly and quickly for an easy turn-

Flight-test programs for the latest jet bombers, transports, and airliners are now utilizing PLEXICODERS for commutation and PDM coding of strain gage and thermocouple data. Feeding into CEC magnetic-tape systems, the PLEXICODERS make possible direct recording of single- or double-ended, positive or negative, low-level inputs for hours of flight time.

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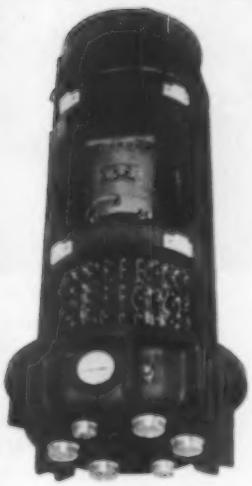

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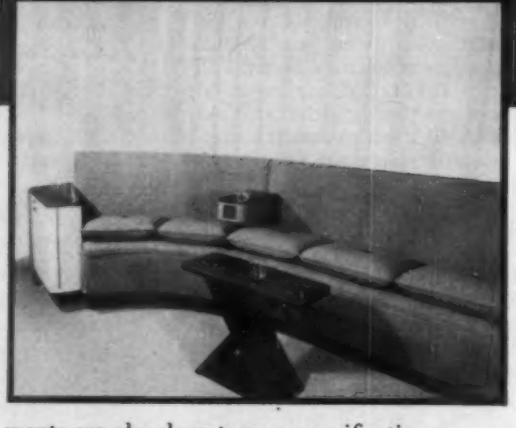

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off onto the strip. No reverse pitch is available but a ground fine pitch setting of 0 deg. may be used for maximum drag during landing roll.

"Ground fine pitch" setting can only be had by lifting and retarding aft of "idling" the pilot's power levers; not the copilot's. Releasing flight-fine pitch stop for this operation does not automatically put the blades in ground fine pitch; it indicates that the blades are free to move into this setting when engine speed falls below 10,500 rpm.

An anti-skid unit is installed on each brake assembly. The unit operates on an inertial principle involving a flywheel which is spring-coupled to the gear wheel. As long as the gear wheel turns faster than, at the same speed as, or slightly slower than the flywheel, the spring will cause the flywheel to assume the same speed of rotation and there will be no effect on the brake system.

However, should the gear wheel suddenly reduce its speed of rotation, as with a skid, the flywheel would overrun its drive spring. This action actuates a mechanism which reduces brake pressure automatically until the gear wheel again rotates at approximately the same speed as the flywheel.

There should be no flight problems with this airplane. Fairchild estimates that about a 5 hr. flight transition will be enough for airline pilots plus, of course, ground training.

Performance characteristics of the F-27 evidence its applicability for military use as a short to medium range transport, and for utilization in aerial photography and charting, evacuation, navigational training and light cargo.

Fairchild is turning out the F-27 at a five-a-month rate working, primarily, on one shift. Increased orders, particularly from the military, could raise the production rate to 20 a month, a figure that can be accommodated with present tooling.

Price of the complete airline version with Dart 511 engines is $590,000; with Dart 528s, $660,000. A 16-passenger executive version, with bladder cells raising its fuel capacity to 1,660 gal., would begin at these figures. A

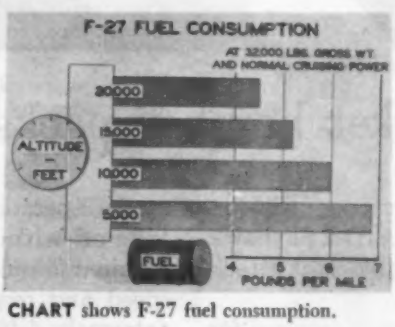
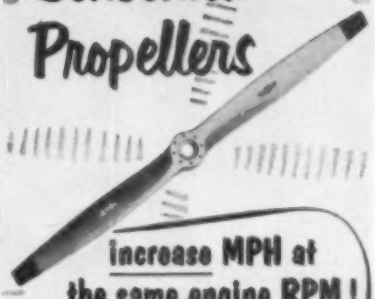


CHART shows F-27 fuel consumption.

Sensenich Propellers



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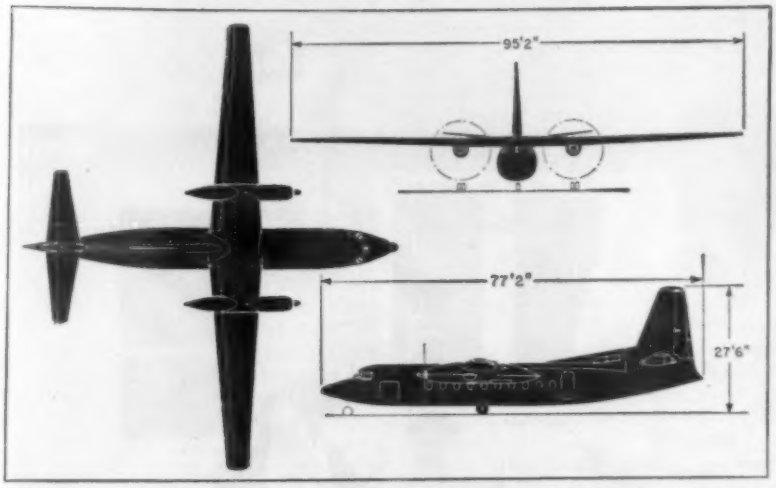

HIGH aspect ratio wing of the F-27 enhances pilot-passenger visibility and affords a level cabin area that sits 43 in. above ground, adding to ground-handling efficiency.

complete commercial package, including interior finishing, avionics and radio equipment and underwing fueling could run to $750,000.

Fairchild's orders to date number 95. Of these, 73 are firm, including 58 to airlines and 15 to corporations. Twenty-two orders are optional, including 21 to airlines and one to a corporation. Four aircraft already have been delivered to West Coast Airlines.

In mid-August the 13th aircraft was rolling off the Hagerstown production line, for September delivery to Avensa Airlines (Venezuela). Number 14 in the five-plane line was also going to Avensa, and the following three were going to Northern Consolidated, West Coast and Piedmont, respectively. The first corporate aircraft will go to General Tire and Rubber Co. in October.

By comparison, Fokker has 41 definite orders for its F-27, the first of which will be delivered to Aer Lingus in October. Of the total, three are executive versions.

Fairchild has predicted a market potential of about 1,000 F-27s, with a dollar volume of some $700 million, during the next 10 years (AW Apr. 28, p. 34). About 300 aircraft must be sold before the break-even point will be reached, AVIATION WEEK was told.

The potential from present airline customers is, roughly, 180 additional aircraft, according to Fairchild. Addi-

F-27 Performance

(Data based on R.Da. 6 Mk 511 engines, standard day, no wind at sea level)

Level flight max. airspeed, 13,800 rpm. at 20,000 ft.	240 kt. (276 mph.)
Level flight max. cruise airspeed, 13,600 rpm. at 20,000 ft.	236 kt. (272 mph.)
Effective range (35,700 lb. at takeoff with 45 min. fuel reserve):	
Internal fuel 1,320 gal.	1,697 s.m.
Internal fuel 1,660 gal.	2,250 s.m.
Rate of climb with 13,800 rpm. at sea level.	1,400 fpm.
Rate of climb, single engine, other at 14,200 rpm.	350 fpm.
Takeoff field length guarantee, gross weight.	3,810 ft.
Landing distance guarantee (34,000 lb.).	3,200 ft.
Stall speed (34,000 lb.).	73 mph. (64 kt.)
Service ceiling at 14,200 rpm.	32,000 ft.
Service ceiling, one engine, other at 14,200 rpm.	13,000 ft.

(Data based on R.Da. 7 Mk. 528 engines, demonstration weight of 34,000 lb.)

Level flight cruising airspeed, 14,000 rpm. at 20,000 ft.	260 kt. (300 mph.)
Rate of climb, 14,400 rpm. at sea level.	1,700 fpm.
Rate of climb, single engine, other at 14,400 rpm.	425 fpm.
Service ceiling at 14,400 rpm.	33,400 ft.
Service ceiling, one engine, other at 14,400 rpm.	14,400 ft.
Takeoff field length guarantee.	3,500 ft.
Landing distance guarantee.	3,300 ft.

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tional sales would be aimed at other airlines and military potential. The company also says there are about 85 potential corporate orders—of which it already has 15—for this category airplane.

Externally, the only difference between the Fairchild and Fokker F-27s is the longer fuselage nose on the American version, in which Bendix weather radar is installed. Internally, there have been many modifications.

For instance, the Fairchild F-27 has 1,320 gal. fuel carried in the outer wing panel while the Dutch model carries 952 gal. Normal refueling of the Fokker version is via filler tanks on top of the wing; Fairchild has added undernacelle refueling as an optional item, as well as installation of bladder tanks outboard of the fuselage which with 1,320 gal. standard fuel, give a total fuel capacity of 1,660 gal.

Another Fairchild optional item is a pressure replenishing system under the nacelle for the addition of water methanol. This system is normally gravity fed.

The company also added a cross-feed line to the 39.6 gal. water-methanol tanks.

The Dutch use an inward-opening sliding passenger door on their F-27. Fairchild, by contrast, installs a pneumatically operated integral step door.

Redux Bonding

About 54% of the total area of the F-27 is assembled via Redux bonding developed by Aero Research, Ltd. Advantages of Redux bonding cited are less weight, longer fatigue life, smoother finish, ease of pressurization, simplification of design and maintenance, and increased strength, as compared with riveted and/or spotwelded joints.

Honeycomb structure is used chiefly in the construction of all surface leading edges and passenger compartment flooring.

The F-27's forward-right baggage-cargo compartment has a floor area of 14.1 sq. ft. and 100 cu. ft. of space. Forward-left compartment has a floor area of 4.6 sq. ft. and 34 cu. ft. of space. Compartment walls are insulated and soundproofed with Fiberglas, with the lower parts being of Conolite to serve as scuff plates against shifting cargo.

Flooring in the forward cargo compartment is designed for floor loading of 150 lb. per sq. ft. over two-thirds of the fuselage width, leaving a passage of approximately 26 in. Flush-type cargo tie-downs are provided in the forward cargo compartment. These are designed for ultimate loads of 2,500 lb. in every direction, up to 45 deg. with vertical. Ultimate vertical load is 1,767 lb.

Some of Fairchild's Canadian and Alaskan customers—Wien-Alaska, Northern Consolidated and Wheeler—are taking a large cargo door, 70 in. x 90 in., instead of the standard-sized 41 in. x 44 in. door. Passenger seats in these aircraft have folding legs and backs and are mounted on tracks installed on top of the regular flooring. Thus they can be removed for the addition of forward cargo.

Air Conditioning

The airplane's air conditioning system integrates heating, cooling, ventilating and pressurization features into one combined system, operating both in flight and on the ground. Engine-driven, positive-displacement blowers supply pressurized air by means of a duct network through both a cooling and heating system into the cabin. During ground operation, engines not running, air is introduced by an electric motor-driven blower.

Pressurization is provided by two Roots-type, positive displacement blowers, one mounted on each engine and driven through the auxiliary gear box. Air is blown into the blowers through an intake duct located on the upper outboard side of each nacelle. A pressure relief valve is incorporated in the main duct to prevent pressure in the ducting from exceeding 10 psi.

On-ground and in-air heating is via a kerosene-fired combustion heater, having an output of 200,000 Btu. per hr. with a fuel consumption of 2¾ gph. The installation comprises a heater, a fuel control system, dual ignition systems, combustion air and heating air systems, and manual and automatic controls.

The heater and associated equipment are located in the air conditioning compartment.

A fixed high pressure 1,800 psi. oxygen system is installed in the crew compartment, providing oxygen for the pilots. The supply will hold for 2 hr. at 20,000 ft. Four portable oxygen cylinders, with disposable masks, are provided for use by the passengers.

Electrical Power

The F-27's electrical power is supplied by a system of electrical power sources, transforming devices and distribution buses. The basic 28-v. d.c. system is energized by two batteries and two engine-driven generators. The basic 115-v. a.c. system is powered by either of two d.c.-driven, single-phase inverters. The 115-v. single-phase a.c. power is reduced to 26-v. single-phase power by a transformer, or is altered to 115-v., three-phase power by means of the pilots' phase adapters.

Should the basic electrical power systems fail, 115-v. three-phase power for operation of the flight instruments is supplied by two engine-driven emergency alternators.

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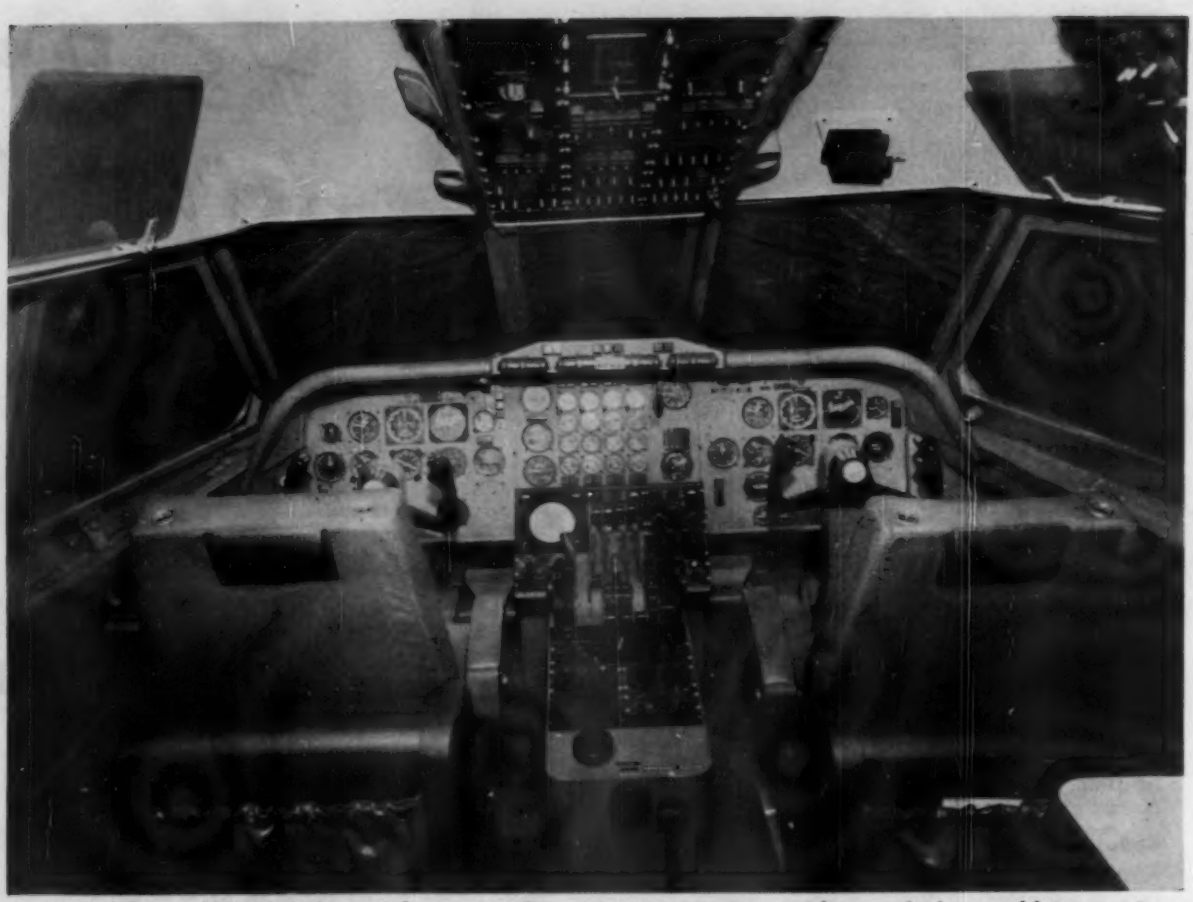


MOCKUP of Convair 880 cockpit shows windscreen area. Communications equipment controls are in the foreground between seats.

Convair 600 Structure Parallels 880's

COPILOT'S flight station, flight instrument panel and console are shown in Convair 880 cockpit mockup. Spoilers are hydraulically actuated; flap control lever has cable link.

By Richard Sweeney

(This is the second of two articles on the Convair 600. The first appeared in last week's issue.)

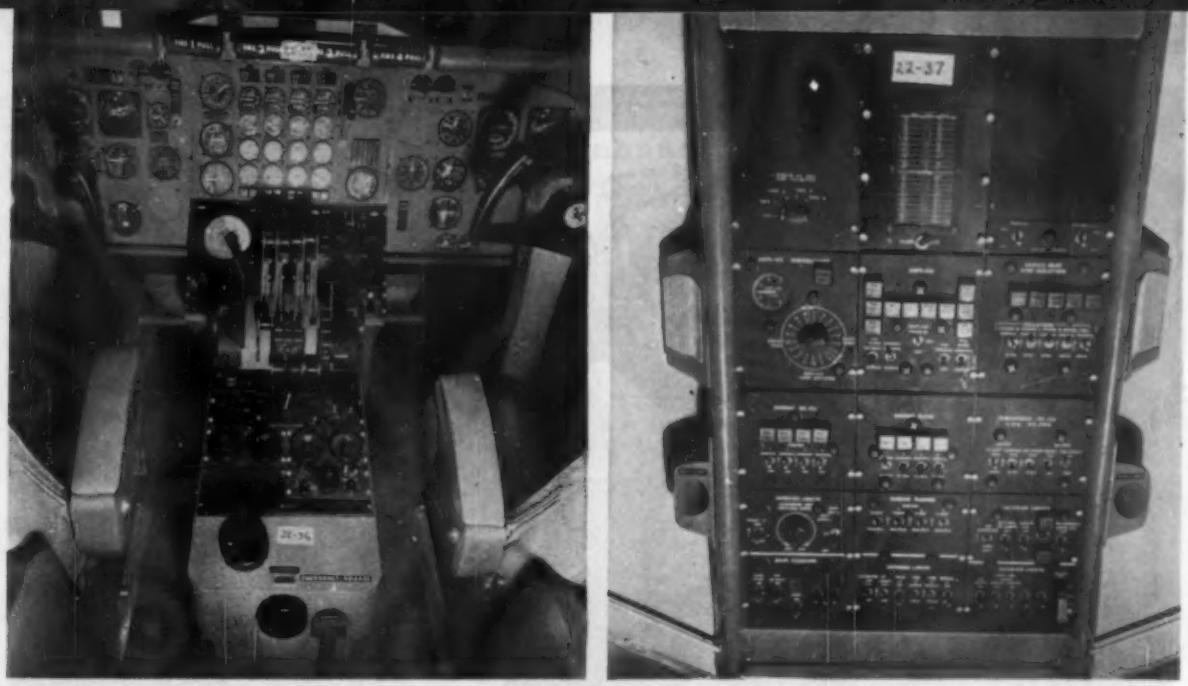
San Diego—Going beyond today's fail-safe standards, Convair has engineered the airframe of its high speed, medium range 600 transport to fatigue criteria which are based on the expected 15- to 20-yr. first line service life of the aircraft.

Structural design of the 600 is conventional in principle and closely parallels that of the 880 (AW June 17, 1957, p. 82).

Strength was increased as applicable to match higher speeds and gross weights, but no major changes in philosophy were required or made.

Materials for the 600, like those of the 880, are suited to primary loads; i.e., 24ST for tension-loaded structure, and higher strength alloys for compression and other members. Forging and casting materials were selected according to strength and configuration requirements.

Dimension gains from the 880 were



CONVAIR 880 cockpit mockup (left) shows engine, speed brake, flap and elevator trim wheel on forward part of pedestal; weather radar console and engine instruments in main panel center. Flight instruments are left and right. Overhead center panel is shown at right.

achieved in 600 fuselage length by the addition to the constant section, while the wing area grew through leading and trailing edge changes.

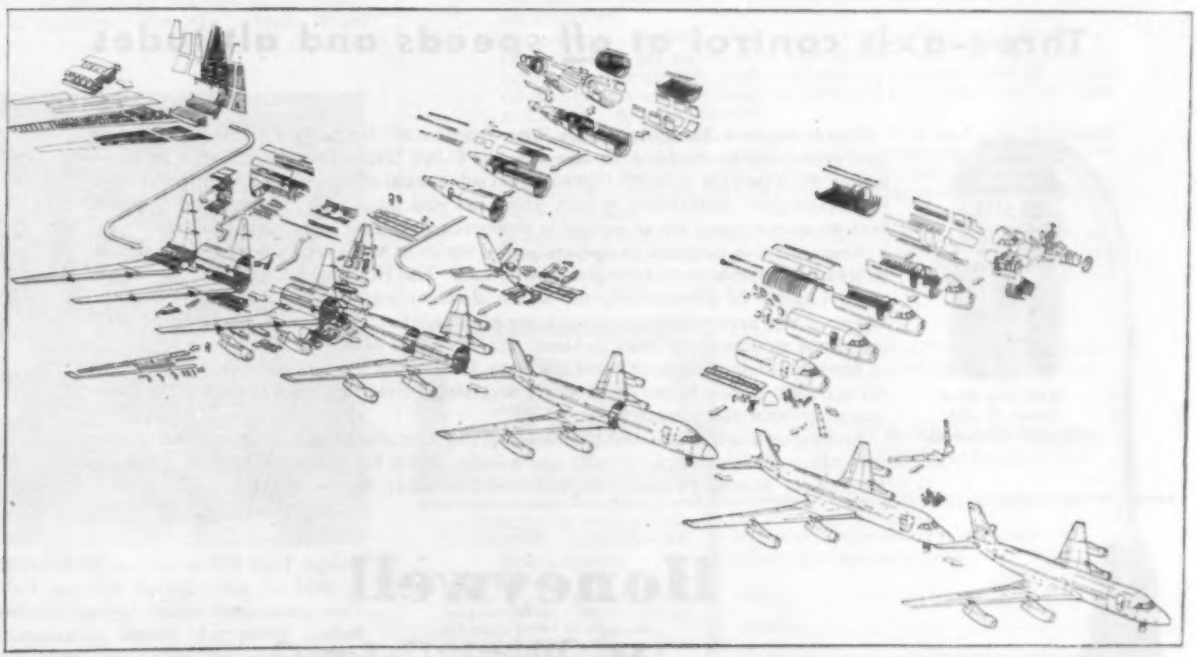
General Electric CJ-805-21 aft fan engines on the 600 required a new nacelle design to provide airflow for the aft compressor. Although several rear fan inlet configurations were possible, Convair chose a common nose inlet, one result of which was fatter engine pods.

Ground clearance for the 600 engines was reduced considerably from that of the 880, which uses General Electric CJ-805-3 turbojets.

To get better ground clearance, the 600 engines were moved forward and up and tilted nose-up in relation to the 880 pod position, the designers keeping in mind the 600 crosswind landing guarantees.

Pods of the 600 have an inner cowling structure immediately around the engine and an outer cowl around this to form an air duct for the aft fan. Double cowling structure retains the standard bottom opening feature of a single cowl and also has small inspection and access doors in which the inner and outer cowl sections move as one unit.

Engine changes on the 600 and 880 are accomplished by either switching the entire power package by removing bolts at pylon-wing attach points, or by



MANUFACTURING sequence of Convair 880 shows how detail parts flow into final assembly. Fuselage will be lengthened on 600.

Three Gnat Gyros in Honeywell Three-Axis Turn Rate Transmitter. Size: 8.6" x 6.3" x 5.24". Weight: 5 pounds.

Convair F-106 all-weather jet interceptor incorporates Honeywell Three-Axis Turn Rate Transmitter in flight control damper system

Three-axis control at *all* speeds and altitudes

Gnat Rate Gyro shown ⅔ size. Weight: 3.8 ounces.

The Honeywell Three-Axis Turn Rate Transmitter, featuring three Gnat miniaturized gyros, was selected for the new Convair F-106 "Delta Dart" all-weather jet interceptor. Built into the stability augmentation sub-system of the jet's flight control system, the Transmitter detects rate of turn about the yaw, pitch and roll axes and responds with an output signal whose voltage is proportional to these input rates of turn.

This system is designed to operate under the most severe environmental conditions to which a combat aircraft might be subjected. The Honeywell Gnat Rate Gyros are easily capable of withstanding the severe shock, vibration and temperature requirements of this application and as such are mounted directly upon the base casting without shock mounts to optimize dynamic characteristics of the system.

The electronic portion of the Turn Rate Transmitter amplifies and demodulates the Gyro output signals to provide polarity reversing d-c outputs proportional to the corresponding input rate to each Gyro.

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disengaging the engine alone from pylon mounts and lowering it away. Fluid and electrical disconnects are provided at both locations.

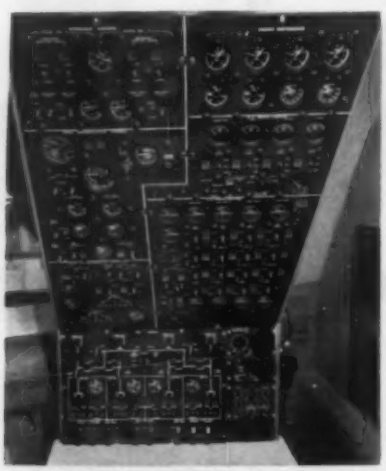
Both the 880 and the 600 have integral pylon-pod-nose cowl structures. Since an aerodynamic seal is required between the engine and nose cowl, special butt seals were designed which accomplish this and provide the necessary separation point for removal of the engine alone. Without the cowl attached, engine teardown and reassembly and major inspections are facilitated as is spare engines handling.

Pod materials on the 600 include titanium shoulders running the entire length of the engine, extending from the horizontal centerline to the vertical. Titanium and stainless steel firewalls, as appropriate, are incorporated in both the 880 and 600 pods and pylons. Pod undersides are aluminum alloy.

Pylons have fluid lines on one side, electrical on the opposite to reduce fire hazard. Compartments are drained and vented.

Installed dry weight of the engines on the 600 is increased about 3,500 lb. per airplane over that of the 880. Part of this weight is contributed by stronger members to absorb higher thrust as well as the added weight of the aft fan component.

General Electric is designing a sound suppressor of unannounced configuration for the 880, and also thrust reversers for the 880 and 600. Clamshell and cascade reverser configuration will be used on 880. A target type reverser is slated for the 600, since the aft fan precludes the use of clamshell and cascades. However, reverse thrust values equal in percentage, to those of



GROUPINGS on Convair 880 flight engineer panel are (left to right—top to bottom): hydraulic control; enigne instruments; cabin pressurization control; d.c. power control; air conditioning control; a.c. power control and fuel control.

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Wing sections of Temco's own TT-1 "Pinto" jet trainer and "Teal" target drone, the wings of the Army's "Hawk" missile, design of the B-58 "Hustler" aft fuselage and other advanced honeycomb structures . . special spiral and other flush mounted antenna systems and large reinforced plastic structures of radome quality . . all are examples of Temco's capabilities in the heat resistance field.

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the clamshell-cascade design are sought for the target installation.

American Airlines' 600 contract does not, as yet, specify installation of sound suppressors. General Electric's noise findings with the aft fan indicate the added mass airflow of the fan changes noise frequencies so that sound power level of the unsuppressed −21 engine is better than those of the suppressed −3 engine.

Airflow straightening vanes are incorporated in the fan shroud of the −21 engine, again contributing to the sound power level changes.

Aft fan engine uses the same basic gas generator unit is a straight turbojet, with its fan utilizing both turbine buckets and fan blades, called bluckets, on a common wheel. A conical shaft carries the fan-turbine wheel, is attached to back end of the gas generator behind regular turbine stages.

Fan component design features turbine bleed air to heat the fan shroud leading edge and air passing through the fan section, to lessen thermal stress created by turbine portion of wheel operating in elevated temperature of exhaust stream while the fan blades are in lower temperature bypass air. Preheating the mass airflow ratio also helps compensate for different thermal expansion ratios.

Sensing Unit

A fan overspeed safety feature consists of an overspeed sensing unit which sends a signal back to the engine fuel control to reduce flow, thereby cutting engine rpm. and exhaust gas flow, which is the only connection between gas generator and free turbine aft fan.

One change in the −21 engine gas generator unit is incorporation of a larger oil tank for the aft fan engine due to longer engine running times planned for 600 operations.

Mounting systems for −3 and −21 differ completely, in that −3 mounting has the main attach points aft of the engine center of gravity and stabilizing attach point forward, while on the −21, the main thrust mounting is just forward of center of gravity while the stabilizing attach point is at the aft fan housing.

Forward portion of the engine incorporates compressor bleed air anti-ice system for inlet guide vanes, center body, and inner and outer lips of the common inlet cowl.

The engine fire detection system utilizes a continuous overheat sensor with indicators in the cockpit serving to locate the area where a hazardous condition exists. Provisions exist for pilot determination, in cases where open flame or other clear visual indication of fire is impossible, or where the condition is a fire or overheat.

Four high pressure bottles of bromotrifluoromethane extinguishing agent are carried, one per pylon. Manifolding interconnects the inboard and outboard bottles on each side. There is no connection between the left wing system and right wing system.

Circuits Isolated

The cockpit fire handle operation cuts all fluid lines to the selected engine, and also exposes a toggle switch which is thrown to discharge the agent into the engine. Electrical circuits for the fire system are completely isolated, and power is supplied from a d.c. emergency power bus.

Primary flight controls of the 880 and 600 have pilot control movements transmitted directly by cable to displace the aerodynamic tabs, which actuate the elevator, aileron and rudder in normal flight regimes. Spoilers as lateral controls are hydraulically actuated with a mechanical mixer providing proper correlation between aileron and spoiler displacement.

Engine controls have cable connections between pilot levers and engine fuel controls and thrust reverser actuation controls.

Secondary flight controls of 600 include primary surface trim systems, flaps, leading edge slots, speed brake functions of spoilers and main landing gear. Secondary controls for the 880 are

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CABLE and WIRE LEADS

by HOWARD E. PENDERGAST
Technical Director Rex Corporation

Factors that influence choice of conductors

Resistance, cost, weight, tensile strength and solderability are important considerations in selecting the best conductor for an application.

Resistance is perhaps the most vital factor. The primary function of a conductor is to carry electrical energy with minimum loss. The resistance of the conductor and its insulating medium influence the degree of potential drop. Resistance is a function of temperature. Typical values for conductors at room temperature are shown below:

Material	Resistivity
Copper	1.72×10^{-6} ohm cm
Aluminum	2.82×10^{-6} ohm cm
Silver	1.62×10^{-6} ohm cm

Cost is chiefly a function of the metal used. Silver would be the obvious choice but for its expense. Copper usually combines the best cost-resistivity ratio.

Weight. Where weight is extremely important and lower conductivity is acceptable, aluminum can be considered. It is preferred for high power transmission lines, for example.

Tensile Strength — "cladding" techniques permit the combination of two metals — one for strength, the other for conductivity. Thus, copper clad steel is now popular for applications calling for high tensile strength.

Solderability is of critical importance for permanent connections. Tin coating by electro-deposition or dipping before final sizing and stranding of conductors is now universal. A growing demand for tin overcoated stranded conductors is prevalent. This offers reduced labor costs during assembly but substantially lowers flexing life and flexibility of the basic stranded conductor. Silver plating is now common with increased demand for high temperature wire. Because manufacturing temperatures are higher than the melting point of tin, silver has been selected as an aid to soldering and a protection for copper. Various alloys of nickel both as plating and cladding are under study as replacements for silver plating. Nickel's high melting point and lack of wicking promise to reduce soldering failures with high temperature wires.

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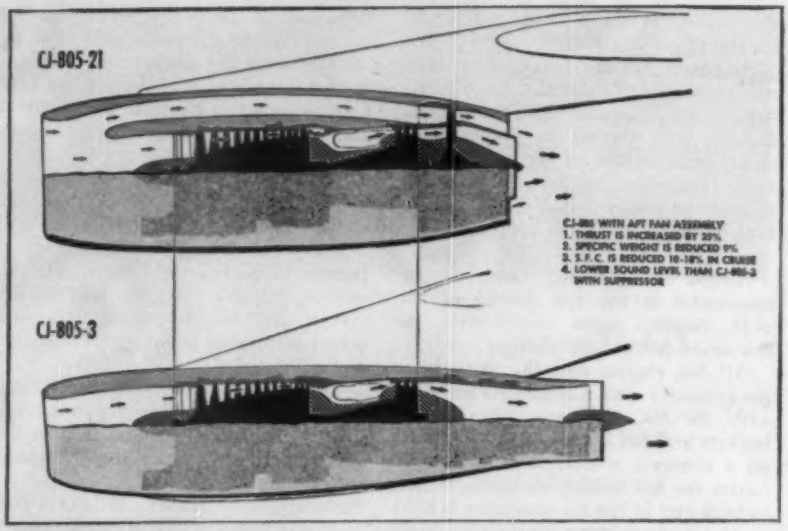

RELATIVE mounting of General Electric CJ-805-3 and CJ-805-21 aft fan engines is shown with common point of gas generator section. Note relative positions of wing leading edge.

the same except that no leading edge devices are used.

With the higher thrust engines of the 600, one change was made in the primary flight controls from those of the 880. Hydraulic boost has been incorporated in the rudder system, to obtain full deflections in asymmetric takeoff thrust conditions. Rudder throw of the 600 is 18 deg. each way, and hydraulic boost cuts in at 9 deg. deflection either way. Boost comes into play as a function of pilot-applied rudder pedal force rather than surface displacement, with a brake-type valve controlling the fluid flow.

The rudder also incorporates a "Q" (dynamic pressure) feel system which provides rudder pedal force proportional to aircraft speed. The system utilizes a piston diaphragm and cylinder assembly, with the piston connected directly to the flight tab actuating linkage. Pitot tube and static ports are used to obtain the differential on pressure and vented sides of the piston diaphragm.

Flight Controls

Refinements of the 880 flight controls have been incorporated in the 600, such as increased effectiveness for elevator balance boards. Also, the aerodynamic tab of the elevator has a chord approximately 25% of that of the main surface.

Lateral control system has undergone changes in view of antishock bodies installation on the wing upper surface. Bodies have decreased the spoiler areas, and although chord has been increased, span reduction is not completely offset.

Acting as aerodynamic fences, the bodies have increased the aileron effectiveness.

Net result is that the 600 has the same roll rates at higher speed as the 880, but in the landing configuration, where spoilers contribute two-thirds of the efficiency, the roll rate is slightly reduced.

Contemplated, after studies were made, is incorporation of 10 deg. of aileron droop at full landing flap deflection. Also, operation might become differential instead of directly proportional, with provisions made in the mechanical mixer of the lateral control system.

Gust Protection

Ground gust protection system for primary control surfaces is an automatic self contained hydraulic damper with no manual selection.

Failsafe provisions are included in primary surfaces, with a preloaded spring cylinder which can be overridden allowing pedals to contact mechanical stops in the rudder system, and sets of overload springs are incorporated in the mechanical mixer of the lateral control system and in the forward area near the pilot controls.

In secondary flight controls, both the 600 and the 880 aileron and rudder trim systems utilize surface tabs which are cable operated from pilot compartment pedestal wheels.

Pitch trim on both airplanes uses a moving stabilizer, mechanically controlled from the normal trim wheel in the pilot compartment. Actuation is by a hydraulically driven jackscrew. One emergency system has electric motor actuation of the jackscrew, while an additional emergency privision has the jackscrew manually actuated through linkage by rotation of an emergency trim wheel in the pilot compartment. In case of any failure, the stabilizer stays in instant position due to the irreversible feature of the mechanism.

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cable link between the pilot pedestal flap control level and the hydraulic motor-actuated flap drive gear box control. Torque tubes connect the single drive gear box to all four flap segments, inboard and outboard on the left and right wing. Tubes rotate the jackscrews which extend and retract flaps mechanically. Asymmetric flap extension provisions are sensing units at the outboard end of the torque tube on each side, which are calibrated so that a bridge circuit is set up when torque tube rotation starts. Should a predetermined differential in torque develop, the bridge collapses and a signal is sent to the flap drive gear box-hydraulic motor unit which immediately stops any flap movement. Flaps stay in the instant position, and no provisions are made to override the asymmetrical sensors and the flap shutoff in flight.

Slots Automatic

Leading edge slots are automatically controlled, extend to full open position when the main flap travel passes 9 deg.

Spoilers as speed brakes have cable control to the mixer unit where design provisions make the system irreversible and prevent aileron feedback when the pilot's speed brake control valve moves. Another direct linkage extends from the mixer to hydraulic valves which control fluid flow in surface actuating cylinders. The mixer operates conventionally to move the spoilers when they are in various settings as speed brakes and the pilot wheel calls for their use as lateral controls.

Main landing gear as alternate speed brake has a special control on the pilot pedestal which is spring loaded to "up" position. The lever actuates linkage which is separate for the most part from that which moves with normal landing gear up-down handle movement, but is tied in to the normal control system somewhat ahead of the hydraulic control valves themselves. Actuation of this speed brake control results in normal main gear extension cycle of doors opening, gear down and locked, doors closing.

The normal landing gear control handle has three positions—up, down and neutral—and operates main and nose gears. When the main gear is extended as a speed brake, retraction is accomplished by moving the normal gear control to "up" position until the gear completes a normal retraction cycle, returning control to the neutral position.

Pilot compartment thrust reverser controls on the 880 consist of secondary levers attached to the main thrust levers (throttles) which rotate through an up-and-back arc. Levers can be moved only when the throttles are in idle position. As levers travel through the first segment of arc to the stops, a signal is generated for pneumatically actuated clamshell doors to close. Stops disappear when the doors reach a full closed position.

During remainder of travel, the levers act as throttles to control thrust level.

600 Thrust Reverser

Thrust reverser controls for the 600 have not yet been firmed. A Convair study indicates a different approach is feasible to reverse thrust control using a target type reverser. In this, the engine would operate at just one power level, probably maximum continuous thrust, throughout all reverser operations. Thrust modulation would be obtained by varying the position of the target doors.

An advantage to pilots is presumed for this method in that the pilot would have high forward thrust available at all times, obtainable by merely opening his target doors, should he decide to abandon an approach or check a descent being made with reverse thrust aid.

An additional lever would be required in this approach, and it would have to

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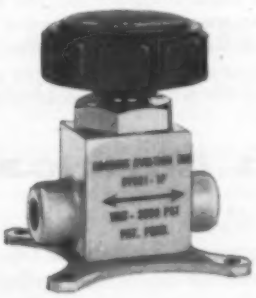

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serve four units simultaneously. If secondary levers such as those used in the clamshell-cascade reverser control were used to establish engine thrust at proper value for reversing, then the extra lever would control all four target positions. Vice versa, if the added lever established the power setting, then secondary levers on the throttle would control target positions.

Hydraulic Systems

Hydraulic systems of the 600 and 880 are basically the same. Both have two independent systems, referred to as No. 1 and No. 2 hydraulic systems. Four engine driven variable displacement pumps supply Skydrol 500 at nominal 3,000 psi. Pumps on the left engines supply the No. 1 system, pumps on the right engines supply the No. 2 system. An auxiliary electric pump is incorporated which supplies both systems, which can be used for ground as well as flight operations.

Each hydraulic system has its own reservoir, and a common manual and remote refill are directly connected to the No. 1 system reservoir which is interconnected for refill to the larger reservoir of the No. 2 system, but at a level which precludes either system draining the other's fluid below safe operating level. This fill interconnect and auxiliary electric pump flow are the only direct associations between the main systems.

Both hydraulic systems are used to operate spoilers, flaps, fuel jettison pumps, and leading edge devices on the 600. These subsystems will operate with either one of the main hydraulic systems inoperative.

No. 1 hydraulic system also operates the horizontal stabilizer trim, rudder power boost, nose landing gear, nose wheel brakes and nose wheel steering. No. 2 hydraulic system also operates the main landing gear, main wheel brakes.

Each main hydraulic system supplies pressure to one actuating cylinder on each inboard spoiler and to two cylinders on each outboard spoiler, for a total of 12 spoiler actuating cylinders. Each spoiler incorporates a mechanically controlled servo valve so that if airloads exceed a specific value, spoilers will blow down with fluid pressure relieved by the main system relief valve.

Moment Reduction

If only one main system is operating the spoilers, hinge moment is reduced approximately one half.

Although main flaps are actuated by torque tubes and jackscrews, the main hydraulic systems each drive one of the two hydraulic motors which power the flap drive gear box which rotates the torque tubes. Either system and its associated motor can operate the flaps alone at reduced load, but with only one half the normal torque. The flap followup control valve shuts off hydraulic pressure when an asymmetric flap condition signal is received from the sensors.

Leading edge slots work similarly to the main flaps, i.e., hydraulic motors power the drive gear box which rotates torque tubes that in turn actuate jackscrews which move the surfaces. Two main differences are that the slots are controlled by the main flap position and have just two positions, fully retracted and fully extended.

Slots also incorporate asymmetry provisions, and while normally powered by both systems, can be operated by one at one half normal torque value.

Hydraulic pressure for the horizontal stabilizer trim is supplied by the No. 1 system. Pilot compartment normal trim wheel movement rotates a followup shaft to move a valve which ports hydraulic pressure to a motor which drives a traveling nut. The nut, motor and followup valve are attached to the stabilizer, and movement up and down of the jackscrew raises or lowers the stabilizer leading edge about an aft pivot point.

A followup mechanism returns the valve to neutral position when the stabilizer reaches a selected location.

Rudder boost system derives pressure from the No. 1 hydraulic system, with a single actuating cylinder used.

Mechanical Locks

The main landing gear, with pressures supplied from No. 2 system, has hydraulic fluid directed through proper valves in sequence to open the main gear doors, retract or extend the gear and then close the doors. Up and down locks are mechanical and are hydraulically operated to latch and unlatch. Main gear doors can be opened and closed from the well when the plane is on the ground.

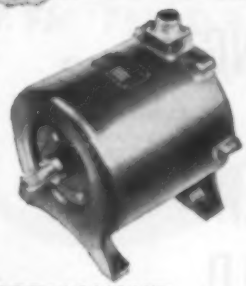
Nose gear operates from No. 1 hydraulic system for retraction, extension, door operation, up and down latching and steering.

For nose gear steering, the landing gear handle must be in the "down" position before hydraulic pressure is passed into the steering cylinder. The pilot's steering wheel has a cable connection to a valve which controls fluid flow into the actuating cylinder.

The same hydraulic systems used for general operation of the main and nose gears power the respective brake systems on the 600.

Trimetallic disk-type brakes are used on the nose and main gear, and antiskid control is provided for both. Additionally, lockout cylinders are incorporated, one for the nose gear, one for each of eight main wheels, to prevent main system fluid loss if a leak develops.

Nose wheel brakes operate only when



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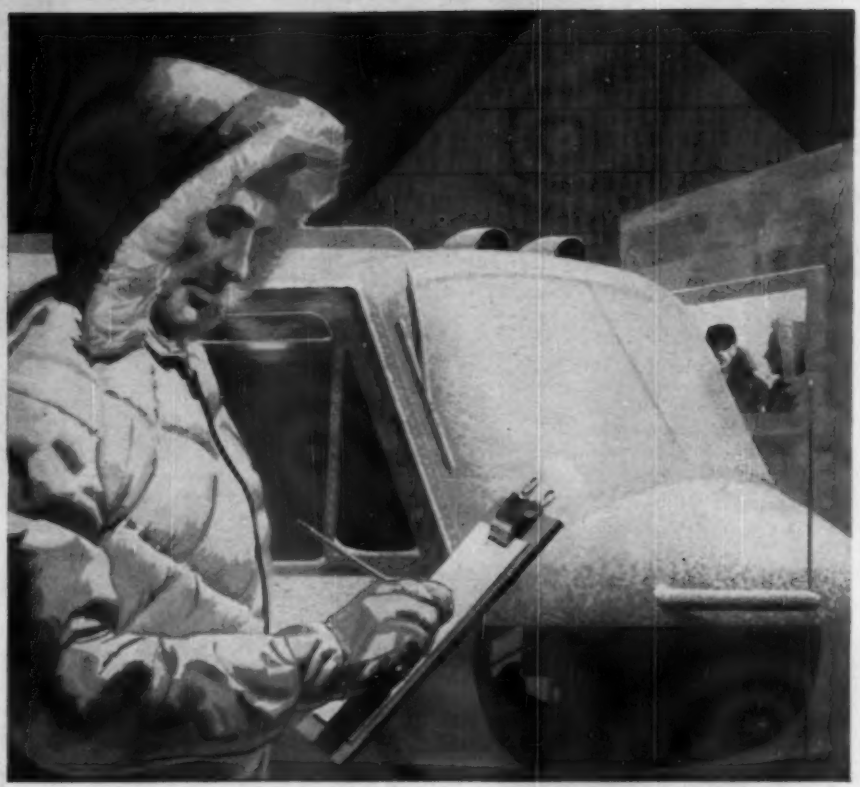

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equal pressure is applied to both brake pedals and also cut out when the nose gear angular travel exceeds 7 deg. from either side of center.

Main gear brakes have an emergency pneumatic operation, with pilot rotation of the emergency brake control valve metering available pneumatic pressure to each of eight main wheels. The pneumatic system has nitrogen stored in a flask with a pressure readout for the pilot. The nitrogen flask is rechargeable on ground.

Electrical System

Electrical system for the 600 is 115-200 volt a.c. and utilizes four 30 kv. alternators for some installations, three 40 kv. alternators in others. Transformer-rectifiers off the alternators provide required d.c. current.

Alternators can operate singly or in parallel and are driven by new General Electric constant speed drives which have fewer parts than comparable equipment.

Static exciters in the system now are located outside the generators and can be spotted any place in the aircraft for accessibility. They provide faster regulation response than the exciters in the generator.

Four load buses and one emergency bus are operable off any alternator.

The system features an automatic control system which is activated by a switch on the flight engineer's panel and which operates from the time external power is plugged into the aircraft until all alternators are going and paralleled after the engine starts. Controls eliminate the need for individual bus switching in normal operation.

Electrical system incorporates a nickel cadium battery, used for its low service requirements, lighter weight and ability to hold a charge longer.

Permanent magnetic generators, actually a generator within a generator, deliver power to operate controls for each of the main alternators, and also yield an isolated second source for d.c. generator control power instead of using the ship's d.c.

Latching relays have been eliminated and magnetic relays substituted. Electrical power is no longer needed to shut down the control system in case of a malfunction.

With either one 30 or 40 kv. alternator failure, all normal electrical loads are still carried. With two alternators out, all essential equipment is operable although some extras such as buffet lights are unusable.

With three alternators failed, essential required equipment still operates, such as electric anti-ice, fuel pumps, flight instruments, fire detection and extinguishing systems. A group of secondary warning lights is partially operable, but such things as the cabin vapor

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cycle air conditioning system is inoperable.

Electrical system control system in the 600 uses magnetic amplifiers and transistors.

Under study and a possible future proposal is a system composed of a gas turbine compressor and air turbine motor which could be mounted in the aircraft to obtain self-sustained system operation.

Gas turbine compressor would be started off the battery and would furnish bleed air to start the aircraft engines and supply air for the air turbine motor which would in turn drive a separate alternator and furnish electrical power. The compressor also would furnish air for operation of a Freon air conditioning system in conjunction with electrical power from the alternator. Installation would replace the air bottle used in starting and would enable the cabin air conditioning system to operate on the ground without outside air or electrical power.

An electrical system feature is a windshield temperature control which keeps a constant power on and applied to the surface and holds the temperature within plus or minus 5F, instead of the usual thermal on-off switch. Automatic controls incorporate magnetic amplifiers which in turn automatically adjust for resistance change due to aging of the windshield material.

Avionics for the 600 and 880 have been racked and packaged to the modular concept and Arinc specification for cooled racks. Resulting plug-in navigation and communication equipment will be easy to check out and replace when malfunction would otherwise delay a flight.

Sensing antennas have been placed in the dorsal fin rather than in the belly, and VHF communication antennas as well. The VHF antennas are heavily top-loaded stubs especially designed for this mounting. Rotating flush loops of the cavity type are mounted in the vertical stabilizer. An isolated portion of the fin is the high frequency antenna.

Radio interference group has a test stand which uses production harness and hardware to check compatibility of avionic components. A functional mockup also is in use.

A thin wall sandwich radome of Fiberglas laminate is used.

On the 600 alone, provisions have been made for Doppler navigation radar, and a dual weather radar readout in the cockpit.

Vapor cycle air conditioning system is standard equipment on the 600 and 880. Freon equipment is used in the refrigeration portion of the air conditioning (AW Dec. 16, 1957, p. 93).

Air distribution systems are separate for passenger and flight crew compartments, with main cabin outlets running along the upper cabin wall at the overhead shelf level.

Anti-Ice Systems

Both the 600 and 880 use hot air and electric anti-ice, with bleed air in wing and engine areas and the electrical type used on empennage.

For the 600, bleed air ducting is extended to the leading edge slots, with a unique telescoping section of tube connecting the 4-in. main duct with slots to maintain anti-ice flow when the slots are extended. Main duct is mounted on the forward face of the front wing spar and has saddle attachments which have provisions for wing flexure.

Slots are dual-sheet construction, a thick outer skin which has depressions chemically milled and a thin inner skin. Anti-ice duct is piccolo tube which releases air into passages between inner and outer skins.

Bleed air on the 880 and 600 comes off at 850F and higher and is ducted hot rather than being cooled before entering ducts. Nominal anti-ice system flow pressure is 13 psi.

Fuel for the 600 is carried in four main wing tanks which have two compartments each, one center section tank with five compartments, four antishock body tanks. Total fuel ca-

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pacity is 101,200 lb., of which 72,150 lb., is in wing integral tanks, 20,750 lb. in center section tank, 8,300 lb. in antishock body tanks.

Fuel system is designed to accommodate JP-1, JP-4 aviation gasoline and kerosene.

Refueling provisions include gravity fill through the top of wing filler openings as well as a pressure fueling system. Pressure fueling has two fittings in each wing, mounted at one location outboard of the outer engine pods. All tanks can be refuled by the pressure system from zero to full capacity in about 15 min.

Pressure refueling control panel is located in each wing directly aft of pressure refueling fittings, and behind rear wing spar. Provisions here are for communication with the pilot compartment and appropriate gages and controls for refueling either across the board or selectively. Wing center section tank may be refueled simultaneously with the mains from pressure fittings.

Refueling sequence has mains filling first, then the antishock body tanks.

Main tanks have fore and aft compartments, the forward section supplying fuel to the engines while the rear replenishes forward. Manifolding is such that while each engine normally receives fuel from its associated main tank, any engine may be run from any tank.

Fuel Circulation

Fuel circulation is by gravity flow, where applicable, and boost pumps. Installation of wells in the main tanks precludes accidental starvation of an engine during maneuvers.

Wing center section fuel is pumped into the manifold which is connected to the left and right wing crossfeed system.

Venting is conventional, and required fuel expansion is provided in the antishock body tanks.

Fuel dump system provides for reducing airplane weight to maximum landing value and utilizes hydraulically driven pumps which can empty the inboard main tanks and electric pumps which can empty the center section tank. Jettison pipes for the 600 are in antishock body rear point, while on the 880 they extend aft from a point about in the center of the outboard main tanks.

Fuel gaging system provides for weight aboard each tank and a totalizer for the weight aboard the aircraft.

Since a variety of engine starting systems is being required by various customers for the 880 and 600, Convair has standardized on an external pneumatic source for the basic airplanes. Air bottle starts with in-line combustion starters on either one or both in-

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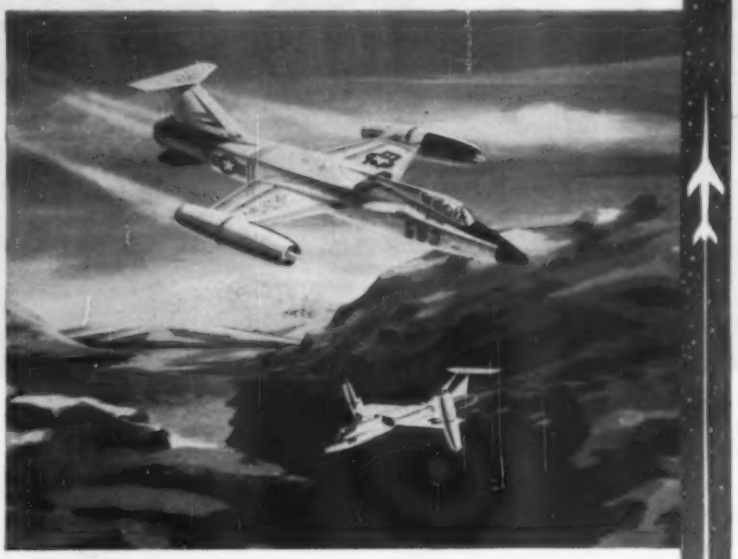

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board engines can be provided if the customer so desires.

Under emergency conditions, the 600 and 880 landing gears can be extended by a system which is basically a gravity drop-lock. Landing gear doors are extended pneumatically and are locked open and stay open.

For emergency descents, the pilot can use the main landing gear and spoilers simultaneously.

If flaps and the leading edge device are stopped by an asymmetry sensor system, they stay in position and the pilot flies with them fixed.

Manufacturing Program

Currently, 90% of the assembly tooling for 880 production is completed and 98% of the detail tooling is finished. Tooling completion is scheduled so that required tools are available when they are needed.

Some 28% of the 880 structural fabrication is subcontracted, with the cost of tooling as well as space requirements limiting the amount which can be accomplished at Convair's San Diego facility.

Plans already have been made for beginning in 600 production, with a start contemplated about the time the 28th airplane of the TWA-Delta 880 order is nearing completion.

Introduction of other versions of the basic 880 such as the 200,000 lb. model and the increased skin gage model, as well as the 600 itself, contemplates having tooling which is adaptable to all where applicable.

A case in point is the main wing box. Inside dimensions of this section are identical for the 880 and 600, so same basic wing bucks are usable. Special fittings accommodate differences created by such things as spar web thickness variations.

Currently, three sets of wing bucks are in use for 880 production. At the proper time, one will be adapted to 600 wing production. As applicable, all will be changed. However, a changeover can be accomplished which will enable reconversion should a large order for the big 880 model come along.

Present planning has the main production line for the 880 proceeding linearly through two buildings, with subassemblies fed in from the side as required.

When 600 production starts, the special tooling required for this model will be located in another building where parts will be fabricated, then taken to the main production line and inserted into the production flow at the proper position.

Tooling such as hydropress, stretch formers and detail tools for such items as gas-tight fittings will be peculiar to each model of the airplane.

Biggest problem is setup time for

large tools such as spar mills. Once a setup is complete, parts can be completed fairly fast.

In assembly tooling, the "also use" philosophy will apply as much as possible. Where one tool can be adapted for dual model production, this will be done, and where tools for simultaneous production of parts for different models are required, tooling for each model will be provided.

Planning requires, where tools must be converted from one model to another, that enough parts will be fabricated before changeover to fulfill the existing program and provide adequate spares.

Tools for Spares

Additionally, tools and capability will always have to be retained for fabrication of certain types of parts for continuing spares requirements. In such situations, special tools will be retained even though they have capability for conversion to another program.

Good planning has been required for the interchange from the basic 880 to the 600 in view of the lead time required for tooling conversion. Adequate stocks of vendor items such as extrusions have been ordered and will be fabricated as required insofar as it is possible to foresee future requirements, although inventories of such items cannot be allowed to get out of hand due to high costs.

With wing buck conversion for the 600 to be started at about airplane No. 28—the early time entry being made to meet flight test schedules—new fuselage manufacturing will also start, although this is expected to be less of a problem than wings. With the additional length being in the constant section, some additional length has been made in nose and tail production sections, while the overwing barrel section remains essentially the same. Airplane is built in three major sections here: the forward, overwing and rear, and the front and back are lengthened for this production phase.

Antishock Body Attachment

Antishock bodies on the wing made assembly too large for a Scotchwelding oven, which has resulted in their being attached by other methods and in bladders being used in the tanks.

Antishock body dimensions are, for the inboard, smaller body, 23 ft. long and 3.3 ft. thick at the maximum point. Larger outboard bodies are 25 ft. long and 4.2 ft. thick.

Manufacturing standards for the 880 and 600 have been set at a point which meets aerodynamic smoothness requirements for surfaces, yet are within tolerances which can be held both in the factory and in line maintenance.

A substantial aid in the 880 program has been the company's metal mockup, in which accurate dimensions can be ascertained for such parts as electrical harness, fuel and hydraulic tubes, and others.

Working with the metal mockup, exact sizes can be determined, reducing the "cut and fit" portion of manufacturing to an absolute minimum.

A real advantage here is that working from a metal mockup, should an unusual part request come in from a remote location, say a request for a piece of hydraulic line which was punctured by an unusual accident, the exact length can be sent which will fit without requiring adjustments and jockeying which would be hard to accomplish on a remote field.

In its test program, Convair has gone through normal structural and acoustic programs and has done a combination thermal-acoustic test on a 228-in. fuselage section.

One result was changeover in the frame between first and second windows (880 and 600 use three panes in each window) from metal to Fiberglas as a thermal insulation, precluding a frosting problem on the middle pane.

Cabin Air Outlets

Much time and money was spent in developing outlets for air into the cabin, with consideration for tooling and production costs, maintenance and efficiency as well as noise level involved. Resulting letter slot principal outlets and special individual passenger eyeball outlets were adjudged worth the effort.

Complete air conditioning system was mocked up and tested.

The airplane's passenger seats went through a "delethalizing" test program to get the best safety levels obtainable.

Having had a large and widespread sale of its last transport, the 240-340-440 series, Convair has a well-established customer service system.

However, with the advent of the jet programs, the service system is being brought up to date to give more and better service, and philosophy is changed somewhat to match jet operations.

Service structure for transports is in two general categories.

The service engineering staff, which is in the plant, handles correspondence of all kinds with customers on their problems.

Field service personnel are similar to the technical representatives (tech reps) of former days.

They work on maintenance and training programs for the customer's people at the customer's site.

Service engineering people do not try to solve customer troubles; instead they can draw on the entire engineering department for talent to obtain a required fix, which they then pass along to the customer.

Within Convair, customer service is in five groups: interceptor, transport, publications, service parts and service operations.

Publications contributes to both military and transport service programs and puts material together as required by field representatives and service engineers.

Publications also is concerned with training aids, working to fulfill requirements laid down by maintenance training group in field service.

Mockups and Trainers

Mockups and systems trainers are obtained by airlines to their own requirements, and Convair will furnish necessary specifications to the airline's trainers contractor.

Service group also makes available to airline's training people a package of training information such as slides, study book and charts.

In parts service, one man is detailed to work with certain airlines, and he is the one they deal with on all transactions, giving him a better insight into their particular operations.

In service engineering, one man will watch a certain customer or group of customers by assignment and thus keeps abreast of individual interests and problems.

The service operations group will have an individual who will be in a position to evaluate Convair's effectiveness with the customer. He will grow to be a service evaluation specialist after 880 and 600 programs are well established and have been operating for some time.

Direct Telephone Line

Convair plans to have, later, a direct phone tie-in to the maintenance centers of all the customers on the 880 program, to expedite service.

Additionally, if a customer's airplane is on the ground with a problem which airline people may not be able to solve immediately, a telephone call would be made to the proper service engineer, who will instruct maintenance people on what to look for, and should a part be needed, he will see that it gets on the next airplane going in the proper direction.

During initial 880 and 600 operations, a Convair man will be stationed wherever there is a major turnaround point for the airplanes, or wherever there is a major maintenance center. At first he will be assigned to a particular customer, later will act as over-all representative to the airplane rather than individual customers.

All technical representatives and instructors will be specialists in their particular areas.

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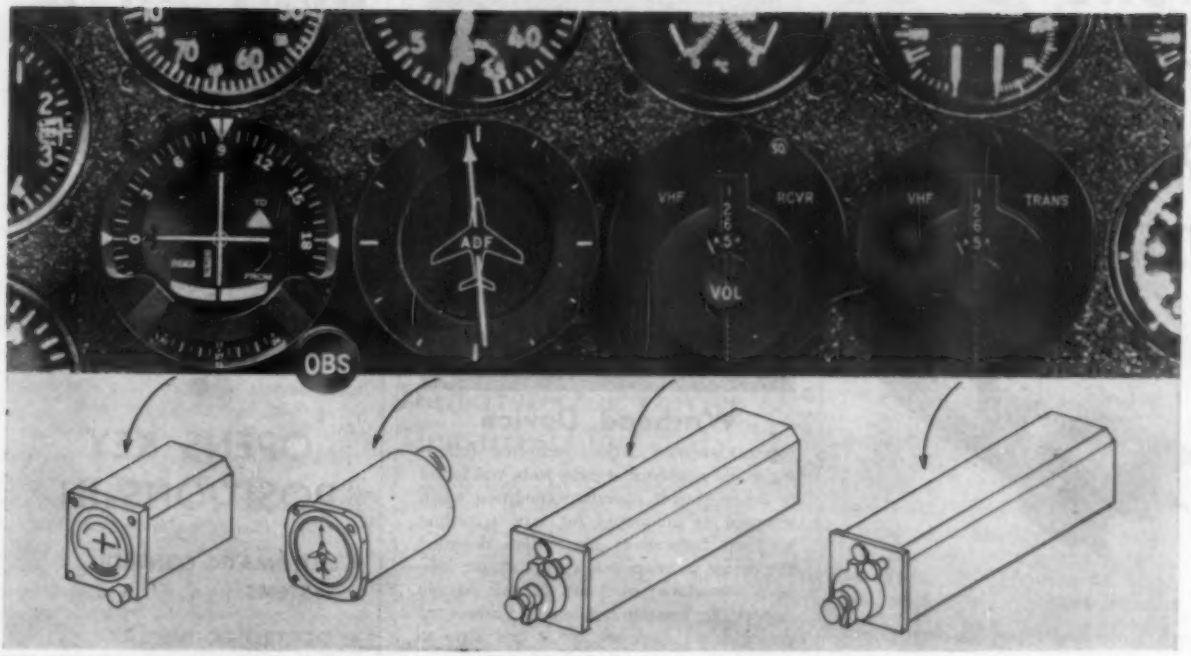


TYPICAL cockpit panel layout for Navcom 100 series equipment. Indicator at left displays visual omnirange and instrument landing system data from navigation module and glide slope receiver. Automatic direction finder display and VHF receiver and transmitter are at right.

Lear Designs Lightplane IFR Equipment

By James A. Fusca

Los Angeles—Line of lightweight, low-cost avionic equipment for private and business aircraft said to meet Civil Aeronautics Board specifications for airline use under instrument flight conditions has been developed by LearCal Division of Lear, Inc.

Major reason for the development program is the opinion of the company that CAB will adopt proposals presently under consideration requiring all aircraft using the airways to be equipped with communications and navigation gear meeting a common standard. Other avionic manufacturers reportedly are developing equipment for the same purpose.

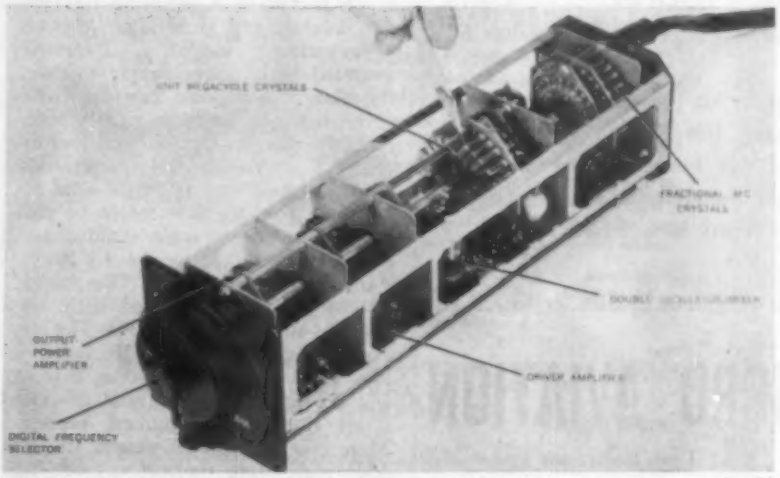
Lear calls its avionic package the Navcom 100 series equipment. Series consists of VHF receivers, transmitters, navigation modules, glide slope receivers, marker beacon receivers, display instruments, and power supply-modulator-audio amplifier modules, in versions capable of 12 or 24 volt operation. Equipment can be assembled in building block fashion so that a private pilot can begin with a minimum installation and expand it as desired.

Lear officials say that Navcom 100 series equipment has been designed to meet all requirements of the CAB's Technical Service Order specifications, but with economy of parts and production including the savings of volume parts purchases.

They anticipate production of 3,000 units this year and a minimum of 6,000 units each year after.

The Navcom 100 line includes:

• **VHF receiver.** Receiver as supplied has 190 crystal controlled channels with 100 kc. spacing over the range between 108.0 and 126.9 mc., with capability of expansion to 240 channels by extending frequency range to 131.9. Channels are tuned digitally with no need for fine tuning. Weight is 3 lb., audio amplifier output is 5 w. When glide slope receiver is added, the unit automatically selects glide slope chan-



NAVCOM 100 VHF transmitter shown with cover removed. Transmitter provides 90 digitally tuned channels spaced 100 kc. apart between 118.0 and 126.9 mc.

NORD CT-20

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Zero launched from its own portable trailer, the CT-20 CAN BE EASILY TRANSPORTED AND OPERATED FROM unprepared areas. Recovery is by parachute.

Designed and built to fly like a fighter, the CT-20 offers high performance at low operating cost with a minimum of ground control and support equipment.

PERFORMANCE

Speed (32,800 FT)	560 MPH
Time to 32,000 FT	6 MIN.
Service Ceiling	40,000 FT.

Production is now underway to supply the French Army, Navy and Air Force. It has also been recommended for use by the US 7th Army in Germany.

For complete details write:

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Warhead Device

Jupiter warhead device, recovered following recent nose-cone re-entry tests, was found to be in perfect operating condition when returned to laboratory for test, according to Ford Instrument Co. which designed the device in cooperation with atomic warhead laboratories of Army Ballistic Missile Agency at Picatinny Arsenal. Purpose of device is not disclosed, but it may serve to control the timing of warhead explosion.

nel when tuned to a localizer frequency.

• **VHF transmitter.** Transmitter comes with 90 crystal controlled channels with 100 kc. spacing over a frequency range of 118.0 to 126.9 mc. and can be extended to 131.9 mc. to supply 140 channels. Transmitter also has digital tuning for direct frequency selection. Average power output under standard test conditions is 4 w. Weight is 2.6 lb.

• **Power supply-modulator-audio** amplifier. Transistorized power supply, modulator and audio amplifier make up a single remotely-located module weighing 2.3 lb. Cost of this unit with transmitter and receiver is $1,095. Power supply is capable of supplying a navigation module and glide slope receiver.

• **Navigation module.** Remotely mounted with power supply module, the navigation module provides visual omnirange and localizer signals automatically to a display indicator, and includes a marker beacon receiver with either an aural or single light-aural indication. Accuracy is stated to be plus or minus one degree under standard test conditions. Module weighs 4.5 lb.

• **Indicator-course selector.** Two models of indicators can be used with the Navcom 100 series equipment. The less expensive model weighs 1.2 lb., incorporates an omni bearing selector, to-from and left-right indications, and provides direct reading of reciprocal bearing. More expensive model weighs 1.5 lb., adds glide slope indication and flag alarms for glide slope and localizer. This

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TWO fixed-loop automatic direction finder antennas at right are being mounted atop DC-6. Lightplane resolver-indicator is at left.

indicator is used with the system when a glide slope receiver is included.

Both 10 and 20 channel glide slope receivers can be added. Correct frequency is selected automatically when localizer frequency is set at the VHF receiver. Optional equipment includes a three light-aural marker beacon receiver which weighs 2 lb. The company's standard Automatic Direction Finder receiver for private pilots (Model ADF-12-E2) which weighs 17.8 lb., can be included with the Navcom 100 equipment.

One of the developments that Lear officials say will have application in both private and commercial aircraft is a flush-mounted, fixed loop antenna system for automatic direction finders. Working on the goniometer principle, a technique which gains certain electromechanical advantages by utilizing two small antennas to reproduce the field present at two much larger antennas, the new system employs:

• **Fixed-loop antenna.** Flush antenna is 20 in. long by 1 in. high and slashes aerodynamic drag of externally-mounted rotating loop ADF antennas. Physically, the antenna consists of two loops wound over a flat ferrite slab, encased and sealed in a plastic housing which mounts either on the top or bottom of an aircraft.

• **Remote sensor.** Remote sensing equipment consists of an RF resolver, servo motor and—for remote indication—a synchro-transmitter. For private and business aircraft, the resolver is mounted within the panel indicator. Commercial aircraft employ a remotely located goniometer unit that drives the radio magnetic indicators on the cockpit panel.

Lear development brings signals from the two large antenna loops to the stator coils of a resolver, with the rotor acting as a search loop. Signal induced in the rotor is a function of the physical position of the rotor relative to the stator windings. Therefore, output of the rotor is identical with the output of an ordinary loop antenna.

Hail Detector Device Measures Electricity

Sleet and hail collisions, a major hazard for jet airliners, may be avoided by the use of a hail detector measuring strength and orientation of any atmospheric electrification field around the airplane.

The strong correlation between atmospheric electricity patterns around clouds and the presence of hail was found by Meteorology Research Inc. of Pasadena, Calif., in carefully controlled experiments with seeded clouds for the Atomic Energy Commission. The company is now studying production of instruments based on that used in the AEC program.

The sensor is two or more static probes with radioactive tip elements to speed local ionization; instrument measures the difference in potential between probes to get an indication of slope and orientation of the electrification gradient. Probes need be no more than 18 in. apart.

They can be rotated about each other for directional indication, or signals from probes in different parts of the airplane can be added vectorially.

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Expansions, Changes In Avionics Industry

Recent changes, expansions and mergers announced by avionics manufacturers include the following:

• **Air Logistics Corp.**, Pasadena, Calif., will purchase **Polaris Engineering** of Inglewood, Calif., engaged in development and manufacture of instrumentation and controls. New subsidiary will be known as **Metrolog Corp.**, will continue to be headed by Dr. Charles J. Breitwieser and Dale H. DeMott.

• **Computer Equipment Corp.** is new name of company formerly known as **Digitron, Inc.**, Los Angeles. New name is intended to better reflect nature of company's business.

• **Fairchild Camera & Instrument Corp.**, Syosset, L. I., N. Y., has purchased assets of **Acme Telectronix division** of NEA Service, Inc., Cleveland, Ohio, producer of telephoto, facsimile and color scanning equipment.

• **Instruments for Industry, Inc.**, has moved into new 38,000 sq. ft. plant at 101 New South Road, Hicksville, N. Y.

• **CBS Laboratories** will move from New York City to new research center on High Ridge Road in Stamford, Conn., early in the fall.

• **Epsco, Inc.**, Boston, Mass., has set up West Coast division at Anaheim, Calif., to design, produce and market high-speed data processing systems. Wallace E. Rianda has been named vice president and general manager of Epsco-West, and William F. Gunning is technical director, with Ralph McCurdy in charge of production.

• **GPE Controls, Inc.**, is new name of the former **Askania Regulator Co.**, a division of General Precision Equipment Corp.

• **Schaevitz Engineering** has moved from Camden, N. J. to new 50,000 sq. ft. plant in Pennsauken, N. J. Company makes instrumentation and controls.

• **Sequoia Wire & Cable Co.** has acquired **Hall-Scott Electronics** of Burbank, Calif., both producers of wire and cable assemblies. Sequoia is division of Mandrel Industries.

• **Raytheon Manufacturing Co.** has created new Government Services division to provide field engineering, installation, repair and overhaul, training and technical publication services to firm's government customers. Orville L. Dewey heads new division.

• **Tempo Instrument Inc.**, Hicksville, N. Y., has moved all its operations into new 10,000 sq. ft. plant on Commercial St., in Hicksville Industrial Park.

Jet Heat Indicator

Jet engine inlet temperature indicator, servo-driven, is reportedly accurate to within one degree in the 500C to 1,000C range, operating from output of chromel-alumel thermocouples. Pointer provides rough indication of temperature, digital counter gives precise figure. Over-temperature red warning light can be pre-set to come on at any 10-deg. point between 0 and 1,200C, with press-to-test feature to check circuit and automatic indication in event of system power failure.

FILTER CENTER

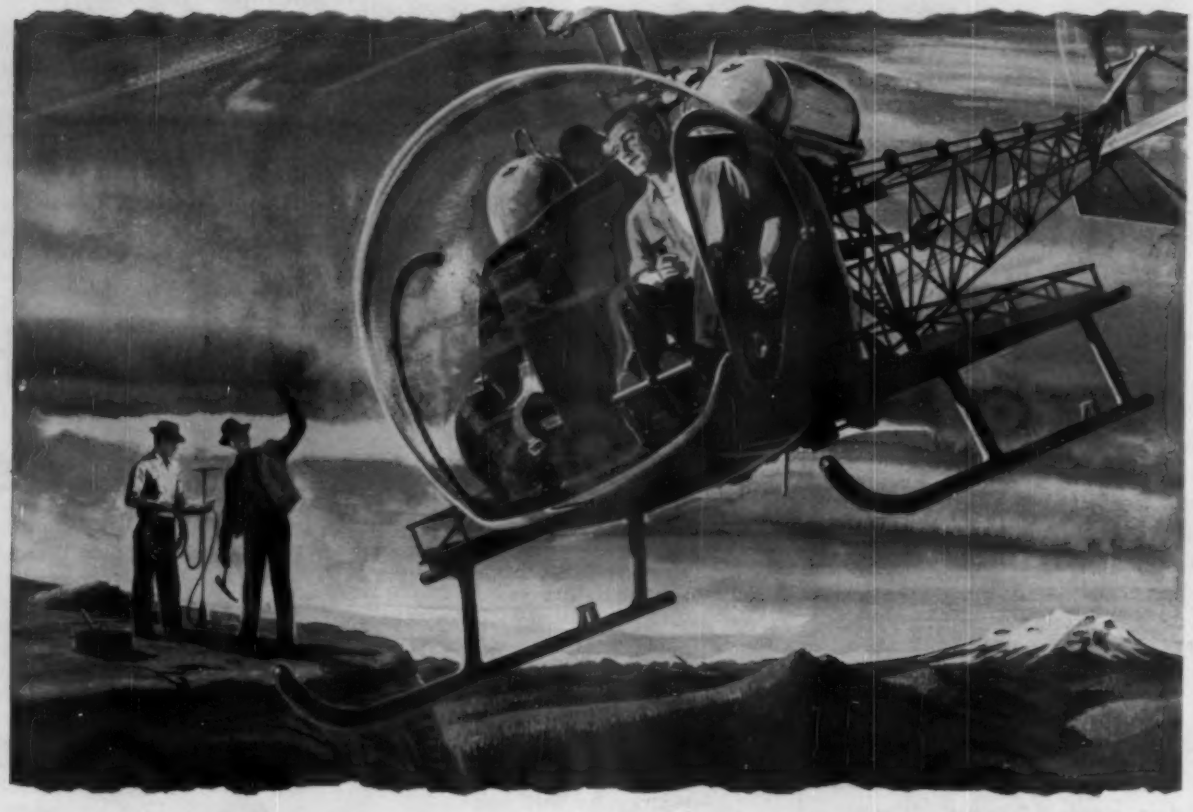
► **Hot Avionics Competition** – North American Aviation Inc. is presiding over one of the hottest competitions in the airborne avionics field—selection of contractors to produce Mission & Traffic Control (M&TC) systems for its F-108 and B-70. Mission & Traffic Control system is similar to Communication, Navigation, Identification (CNI) integrated package, but also includes station-keeping and rendezvous capability. Bids for the F-108 business have been at North American for some weeks, while those for B-70 were due last week. Companies bidding for B-70 include: Bendix Radio, Federal Telecommunication Laboratories, Hughes Aircraft, Packard-Bell, Radio Corp. of America and a team headed by Collins Radio which includes General Electric, Sperry Gyro and Hazeltine. Collins is considered a top contender because of its CNI system experience on the F-105, F4H, F8U-3 and A3J.

► **Weather Radar on TV**—Novel market for airline weather radar has been developed by Collins Radio. Two television stations, one in Dallas and the other in Cedar Rapids, Iowa, have installed weather radar in their studios and televise the radar scope picture during their weather telecasts. Plastic overlay shows location of radar-detected storms with a superimposed map of the local area.

► **Blimp Navigator**—Compact 30 lb. Doppler navigator, AN/APN-77, installed on Navy blimp which recently completed Arctic mission, provided crew with indication of blimp's ground speed as well as movement in any direction across a vertical and horizontal plane. Developed by Sanders Associates, lightweight system employs continuous-wave techniques.

PLANE FAX

by STANDARD OIL COMPANY OF CALIFORNIA



Flying the Yukon air trails for "black gold"!

The Alaskan Yukon country is one of the world's roughest spots to search for oil . . . even by air. Helicopter pilot Budd Darling, of Skyways Inc., Portland, Oregon, specializes in flying geologists and oil survey parties into remote and unusual areas, inaccessible to other types of aircraft. To allow examination of outcroppings or collection of ore samples, he frequently touches down on mountain ridges just wide enough to take the skids of his helicopter, a Bell 47G2, with a 260 h.p. Lycoming engine.

"Maneuvering through difficult areas requires instant engine response at all times, including frequent use of full emergency power," says Budd Darling. "We can't take chances on spark plug fouling or rough running. That's why we use Chevron Aviation Gasoline and RPM Aviation Oil Compounded." Skyways Inc., uses Chevron and RPM Aviation Products exclusively for their home-based operations at Portland's Troutdale Airport as well as their Alaskan flights.

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Support Gear Tailored to B-58 Systems

By Craig Lewis

Ft. Worth—Applying the weapon system concept to the ground support problem, Convair is designing a detailed maintenance program for the B-58 which calls for development of ground support equipment specifically tailored to the bomber's sophisticated systems.

Convair design of the B-58 maintenance plan marks a departure from previous practice. It permits development of a family of ground support equipment which is matched to the airplane's complex systems and closely related to a single, integrated maintenance and operation plan.

The plan covers Air Force maintenance on squadron, field and depot levels, and it includes all the test gear, ground handling equipment and tools which will be involved in maintaining and overhauling the B-58.

Wherever possible, standard ground support gear is incorporated in the plan. Equipment for airframe maintenance, for instance, is not too different from that used on previous aircraft, and the B-58 will require the usual variety of workstands, slings, towbars, jacks and similar gear.

Specialized Equipment

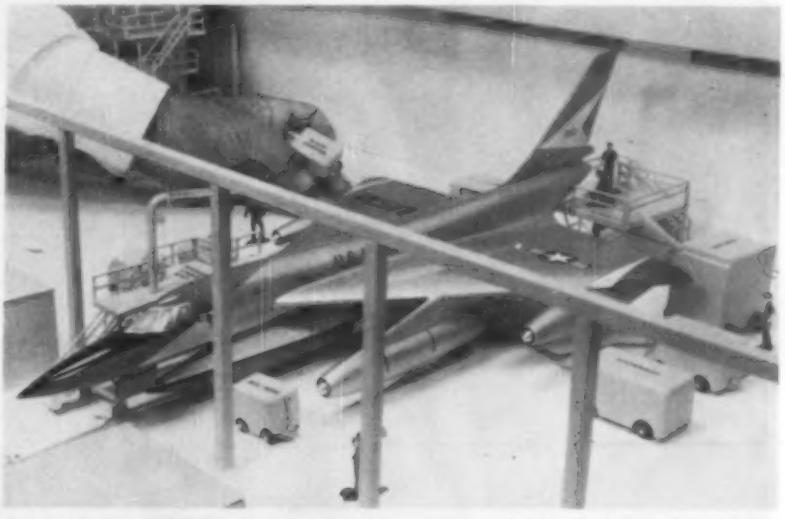
Some of the equipment must be specialized, however, and it is in this area that the weapon system concept is especially valuable. System characteristics and special requirements can be determined at an early stage so ground support equipment can be designed and developed along with the airplane so as to be ready to operate when it goes into service. Equipment for the B-58 is scheduled to be on site and ready to go 30 days before Strategic Air Command gets its first B-58.

One problem is created by the unique pod in which the B-58 carries weapons, fuel or other gear on its various missions. Current bomb hoisting and loading gear is not too efficient for handling the pod, so Convair has under way a major effort to design gear which will make it easy for Air Force crews with low skill levels to handle and load pod.

Another major development area involves the test equipment needed to check out the complex electronic and electromechanical systems in the B-58. The bomber represents an advanced state of aircraft development, and the gear used to test its systems and keep it ready to fight must also reflect technology in keeping with this advanced development.

This test gear generally falls into four categories:

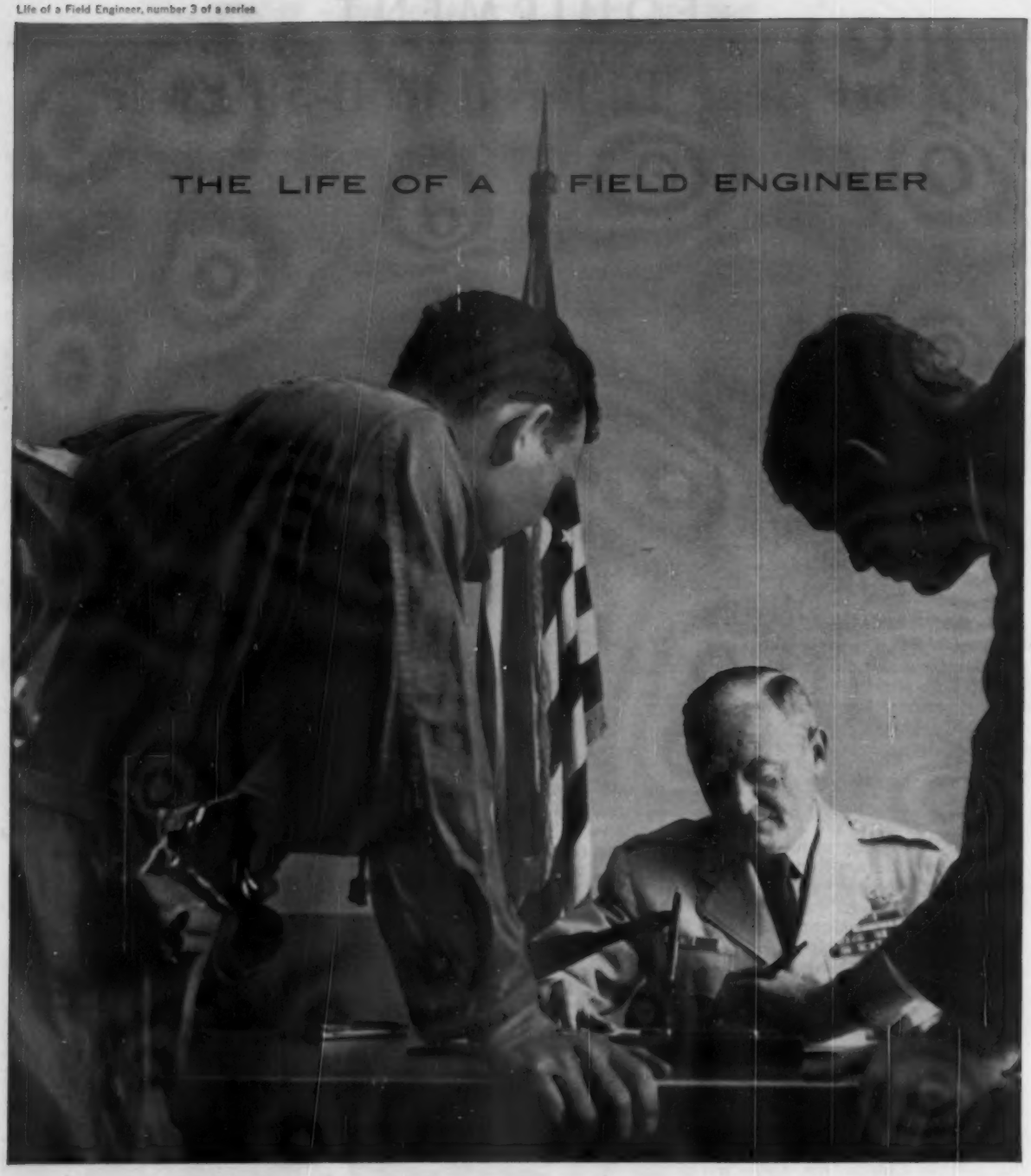
- **Confidence testers**—small, portable, simple testers for flight line use. They determine over-all operating condition of the system on a go, no-go basis.
- **Subsystem evaluation testers**—used in periodic inspection for complete system evaluation. They have automatic go, no-go features, can isolate malfunctions and are self-checking. Modular construction gives them flexibility, simplifies maintenance or repair of the test gear itself.
- **Component testers**—used in the airframe and engine shop. They can test line replaceable units to see whether the operation of components is within



CONVAIR uses models to plan its ground support system for the B-58. Stands and other equipment for airframe maintenance are standard, but have been specially designed for the B-58 weapon system. Electronic equipment for checking out the bomber's sophisticated systems has been specifically designed for them and is self contained in mobile units.

B-58 is prepared for testing under temperature conditions ranging from —65F to +165F at the Air Force's Climatic Laboratory, Eglin AFB. Laboratory measures 200 x 250 ft.

Life of a Field Engineer, number 3 of a series



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allowable tolerance. Malfunctions can be isolated to a replaceable subassembly.

• **Depot equipment**—includes items of field and flight line gear, adapted for depot use, plus standard test equipment.

A number of design objectives were considered in the development of tactical ground support equipment. A basic purpose was to give the B-58 a high in-commission rate, so Convair aimed at a simple, rapid test and troubleshooting system which would involve a minimum of ground operating time. Keeping USAF personnel problems in mind, the engineers designed for minimum requirements for personnel of high skill levels and for minimum training requirements.

Reliability Factor

Reliability is a key necessity in the test equipment. In addition, Convair is trying to develop a system that will afford easy maintenance at the base level, thus cutting the need for spares. A minimum of maintenance man-hours and the lowest cost commensurate with operational and maintenance requirements were other goals.

The B-58 was designed for easy maintenance, and each system and subsystem has test points on the aircraft for evaluation. Systems are packaged in components, called line replaceable units, which are quickly and easily replaced. These line replaceable units can then be taken to the shop and malfunctions can be traced to plug-in type subcomponents.

Confidence testers are relatively simple devices used on the flight line to indicate catastrophic failure. One example is the 60 lb. IFF (Identification Friend or Foe) system tester that is set up in front of the airplane. It measures 12 x 12 x 18 in. and has a telescoping antenna that extends to a 6 ft. height.

Should a confidence tester show a system failure, the ground crew can wheel up the appropriate subsystem evaluation tester and isolate the faulty line replaceable unit for removal and replacement.

This test gear generally is go, no-go type equipment and has simple readouts designed for use by relatively unskilled USAF flight crews.

Mobile test units are self-contained and run off the same ground unit power source feeding the B-58 system being tested. They have analog or digital computers in them, depending on the type used in the system tested. Testing is programmed with punched tape, and the unit produces a simple readout designed for an unskilled operator. Since maintenance men must be sure that any malfunction that occurs is in the B-58 system and not in the test system, the test units have a self-check program they have worked up and which they

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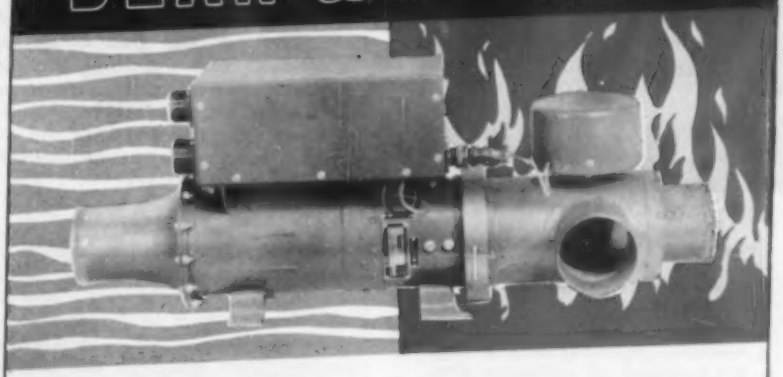

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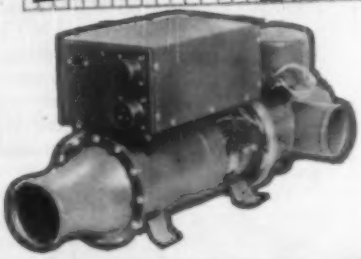

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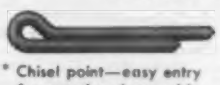

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- 90-360 channel receiver (108-135.95 mc)
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run through before the test program.

Convair designed these complex, tailored test units only where B-58 system complexity demanded it and stuck to simpler means of testing where possible.

Thus, a simple checkout is used on communications and civil navigation systems. But with something like the autopilot or defensive electronic countermeasure systems, where simple checking would take too long and require too much skill, a more sophisticated approach was taken.

Maintenance Program

In the shop area, Convair expects to develop a greater capability for doing maintenance at the base level, thus cutting down on spares in the pipeline to maintenance depots. Each SAC base using the B-58 will have one of the shops provided for in the Convair plan.

Specially designed B-58 shop test equipment is modular, and some of it is interchangeable with flight line test modules.

John Heit, Convair ground support group engineer, points out that the B-58 maintenance plan represents a significant departure from previous systems. He recalls that with the B-36, mockups were made in the shop from whatever airborne parts were available and faulty systems plugged into them for testing. Heit says that B-58 test gear will improve on this situation by not only spotting problems, but by isolating malfunctions and telling what is wrong so repairs can be made at the base level. Ground test equipment designed as such is also more reliable than airborne equipment converted to ground test use.

Test equipment for the B-58 maintenance plan is now in the development stage. Convair has basic assemblies made on it, and some of it is in production. Convair is making some of the equipment, and other units have been subcontracted to the vendors who designed the airborne systems to be tested.

Navy Contracts

Following is a list of unclassified contracts for $25,000 and over as released by Navy contracting offices.

NAVY DEPARTMENT, BUREAU OF SHIPS, Washington 25, D. C.

Control Data Corp., Minneapolis, Minn., digital data processing system, NObsr-75411 (INV no. 882-87563Q), spec. no. SHIPS-D-2980, 1 ea., $600,000.

Servonics, Inc., Alexandria, Va., fabricate and furnish 101 AN/SPS-T2 radar trainers, NObsr-75404 (INV. no. 882B-87547Q) spec. no. SHIPS-T-3073, $2,117,665.

Christie Electric Corp., Los Angeles, Calif., the following items were awarded under contract NObs-74695 (INV. no. 560-338 (b)Q) power supply metallic rectifier, missile testing, types I and II, 70 ea.; type I power supply testing, 1 ea., spec. no. MIL-P-19421A(SHIPS), spec. no. MIL-P-19566 (SHIPS), $164,917.

A. P. Whittaker & Sons, Randolph, Mass., composite approach lighting at the USNAS, Quonset Point, R. I., (IFB spec. no., 16533/77B), $51,450.

AMC Contracts

Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

Philco Corp., Philadelphia, Pa., services and materials for modernization of CMT-4 microwave equipments, (PR PM-8-S-5223), $176,500.

American Machine and Metals, Inc., Sellersville, Pa., indicator, oil pressure, type MS28010-2 for F-100F, T-33A, T-37A and H-40A aircraft, (PR PE-8-05D-3658), $29,340.

Southern, Waldrip and Harvick, Long Beach, Calif., aircraft maintenance docks, type SHU-4/F(MB-12W) and erection of such docks for servicing KC-97 and KC-135 aircraft, (PR PM-8-X-5604, 5626, 5623, 5622, 5617, 5618), $2,090,856.

National Broadcasting Co., Inc., New York, kinescopes and prints of the television program "Chapel of the Air," (PR PM-8-PP-5658), $50,928.

Leonard Anderson Associates, Inc., New York, production of 35mm motion picture, sound and color, entitled, "Force for Space," (PR PM-8-MP-5713), $28,020.

Consolidated Diesel Electric Corp., Stamford, Conn., type MC-1 airfield vacuum sweepers and maintenance data and engineering data for same, (PR MP-8-50B-20226 and amendments nos. 1, 2 and 3 and MIPR R58-4717-59-NOas), $1,140,340.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., computer, central air data system, indicator, true airspeed, converter, and compensator, (PR PE-8-05C-3460), $2,228,420.

Sperry Gyroscope Co. Division, Sperry-Rand Corp., Great Neck, L. I., N. Y., controls, amplifiers, compensators, and transmitters, spare parts, ground support, and data for support of Army aircraft and USAF T-33A aircraft, (PR PE-8-05A-3610 and MIPR R-02-897052-SC-09-23 and amendments 1, 2, 2A and 3), $1,355,286.

Bell and Howell Co., Chicago, Ill., motion picture cameras and ground support equipment, (MIPR R58-170/ASO/12NSF/F2/6 and amendment no. 1), $29,499.

The Goodyear Tire and Rubber Co., Akron, Ohio, wheel assemblies, nose, 36", for B-26, B-50 and KC-97 aircraft, (PR 00-8-03B-1110), $195,800.

Microphase Corp., Greenwich, Conn., filter, band pass, band suppression F-339/A for F-101B and KC-135 aircraft (PR PE-8-16K1-3426 and 3492), $69,560.

Oscar Fisher Co., Inc., Newburgh, N. Y., film processor, type EH-9, and ground support equipment, (MIPR R58-4897-110-NOas), $278,100.

Associated Missile Products Co. Division, American Machine and Foundry Co., Pomona, Calif., AN/GPS-T4 radar target simulator trainer, spare parts, engineering data and maintenance data, (PR PH-8-28-7151), $1,629,911.

The Leland Electric Co. Division, American Machine and Foundry Co., Dayton, Ohio, inverters, 2,500 volts output, 400 cycle, single phase, 28 volts input dc, applicable to the C-130 aircraft (PR SA-8-03C-4740), $28,733.

Page Communications Engineers, Inc., Washington, D. C., relocation and expansion of the Wachusetts to Weatover VHF communication link and the engineering and rehabilitation of the AN/TCC035, (PR PM-8-S-5640 and -1), $150,790.

International Telephone and Telegraph Corp., New York, complete operation and maintenance of the tropospheric scatter communications system between San Pablo AFB, Spain, and Sidi Slimane AFB, Morocco, (PR PM-8-S-5169), $377,325.

David Clark Co., Inc., Worcester, Mass., full pressure suits, altitude, required for use by the North American X-15 research vehicle project pilots in a flight test and pilot familiarization program, (PYR MH-8-8415-935), $199,638.

COMPLETE

WHO'S WHERE

(Continued from page 23)

Changes

John C. O'Connell, executive assistant to the president, Coleman Engineering Co., Inc., Torrance, Calif.

Capt. W. C. Felts (USN, ret.), administrative assistant to the president, Electro Engineering Works, San Leandro, Calif.

ITT Laboratories, research division of International Telephone and Telegraph Corp., Nutley, N. J., has appointed the following laboratory directors: **Ben Alexander**, avionic systems; **Anthony M. Casabona**, avionic transmission; **Wilburn S. Chaskin**, communication systems (Palo Alto, Calif.); **Albert E. Cookson**, missile guidance; **Leonard E. Gough**, electronic countermeasures (Ft. Wayne, Ind.); **Leon Himmel**, defense countermeasures; **J. Alvin Henderson**, components and instrumentation (Ft. Wayne, Ind.); **Christian C. Larson**, infrared systems (San Fernando, Calif.); **Keith L. Liston**, communication systems (Chicago, Ill.); **William Sichak**, radio communication.

Guy K. Patterson, chief engineer, Sierra Electronic Corp., a subsidiary of Philco Corp., Menlo Park, Calif.

Ted Dunnegan, Jr., chief of advanced studies, Temco Aircraft Corp., Dallas, Tex. Also: **A. A. Horak, Dr. A. W. McMurtrey, Jr.**, and **C. R. Rutherford**, scientists for advanced studies.

Harrison F. Edwards, technical operations manager, and **Harlan C. Pringle**, field operations manager, Contracts and Service Division, Simmonds Aerocessories, Inc., Tarrytown, N. Y.

Marvin R. Gore, head-systems analysis department, Avionics Division, Aerojet-General Corp., Azusa, Calif.

John F. Carey, head of military sales-electrical products group, The Electric Auto-Lite Co., Toledo, Ohio.

Col. Kenneth A. Gaskin (USAF, ret.), coordinator of the newly established aviation product marketing, The Atlantic Refining Co., Philadelphia, Pa.

Burt L. Fielding, manager-engineering sales, Electronic Systems Division, Dalmo Victor Co., Belmont, Calif.

Rodney W. Meyer, director-newly established international department, Marketing Division, Consolidated Electrodynamics Corp., Pasadena, Calif.

Charles W. Wallace, test base services department manager, Lockheed Missile Systems Division base, Cape Canaveral, Fla. **Lylle D. Bishop** succeeds Mr. Wallace as assistant manager of Lockheed's test facility at Holloman AFB.

Vern Landis, Jr., corporate general manager, Tamar Electronics, Inc., Los Angeles, Calif.

John F. Murray, chief product engineer, Pesco Products and Wooster Divisions, Borg-Warner Corp., Bedford, Ohio.

E. P. Heil, Jr., manager-contracts and sales, and **J. Alan Banzhaf**, manager-manufacturing, Carmody Corp., Buffalo, N. Y.

R. W. Martin, director-engineering and sales, Burton Manufacturing Co., Santa Monica, Calif.

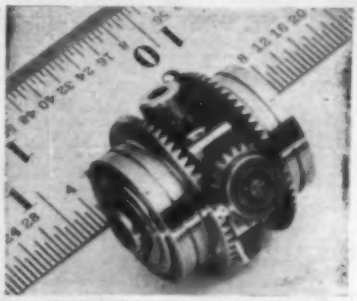
Harold McGraw, manager-military products marketing, Avion Division, ACF Industries Inc., Alexandria, Va.

MICRO-BEARING ABSTRACTS

by **A. N. DANIELS**, *President*
New Hampshire Ball Bearings, Inc.

MINIATURE BEARINGS AND GEAR DIFFERENTIAL BACKLASH

(NOTE: We are grateful to W. J. Opocensky, Staff Engineer, Librascope, Inc., Glendale, California, for his factual report on the part played by our bearings in the design of the small two-pinion differential illustrated below.)



LIBRASCOPE 3/16" HOLLOW SHAFT DIFFERENTIAL uses special duplex MICRO-BEARINGS in all gears. Specifications are: Working circle 1.090", Length .980"; Input gear hole size .687", Starting torque .2 in. oz. — Maximum backlash 5 min. at 2 in. oz.

Miniaturization of precision ball bearings and gears is well advanced. However, putting them together to produce a small differential with low torque and backlash of five minutes or less is no simple task. Loads on single pinion differentials and on single ball bearings introduce objectionable flexibility. So does uncontrolled radial play in ball bearings whether used singly or in pairs.

After considering many designs, Librascope selected a two-pinion differential as the most logical type to develop. A "hunting tooth" gear ratio was also chosen to distribute wear evenly. Double bearings preloaded were to be used in all gears.

Special miniature bearings were developed to give duplex bearing performance at a cost only slightly higher than regular catalog prices.

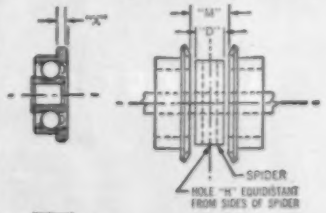


FIG. 1 FIG. 2

Dimension "X" in *Fig. 1* is coded in increments of .0002" under given axial load.

In *Fig. 2* the mounting distance "M" of the bevel gears is known. With the new bearing dimension "X" it is possible to determine the "spider" dimension "D". This provides the desirable mounting distance of bevel gears without shims.

To obtain maximum distance between raceways in limited space, narrow unshielded bearings were selected. To provide dust protection for the bearing a thin shim slightly smaller than the I. D. of the outer bearing race is used between bearing and Truarc ring. Truarcs are stainless steel double-disc-ground to various specific dimensions. With all dimensions controlled, bevel gears are accurately located from the pinion shaft hole, and any desired preload in the bearing can be obtained by selecting a Truarc of proper thickness.

Control of radial play of bearings in pinions presented a different, though similar, problem. Space limitations in the pinion are much more severe than with bevel gears. *Fig. 3* shows how Librascope solved the problem. Dimension "X" is coded in increments of .0001" with a given axial load, from inner race to outer race opposite the flange side on the one hand and opposite the ball retainer side on the other. A precision shim is used between outer races of the two bearings. By selection and use of new coded dimensions, any desired preload of bearings is obtained by fitting bearings to the shim.

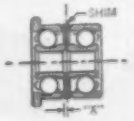


FIG. 3

To keep bearing races in mutual contact, another novel idea is used. Each pinion has its own adjustable shaft. The outside end of the pinion shaft is fitted with a Truarc. This rests against inner race of outside bearing. To overcome the limited adjustment of shims and expensive labor costs, a unique adjustable washer is used. By means of a special tool, each pinion may be adjusted for any desired amount of backlash. Bearings are held at preload by adjustable washer and Truarc. A clamping means secures pinion shaft to "spider".

The Librascope differential design makes possible "5 minute" differentials at 2 in. oz. loads. Measurements are taken at *eight* equally spaced positions for one full turn of the "spider". The maximum backlash recorded determines classification of differential.

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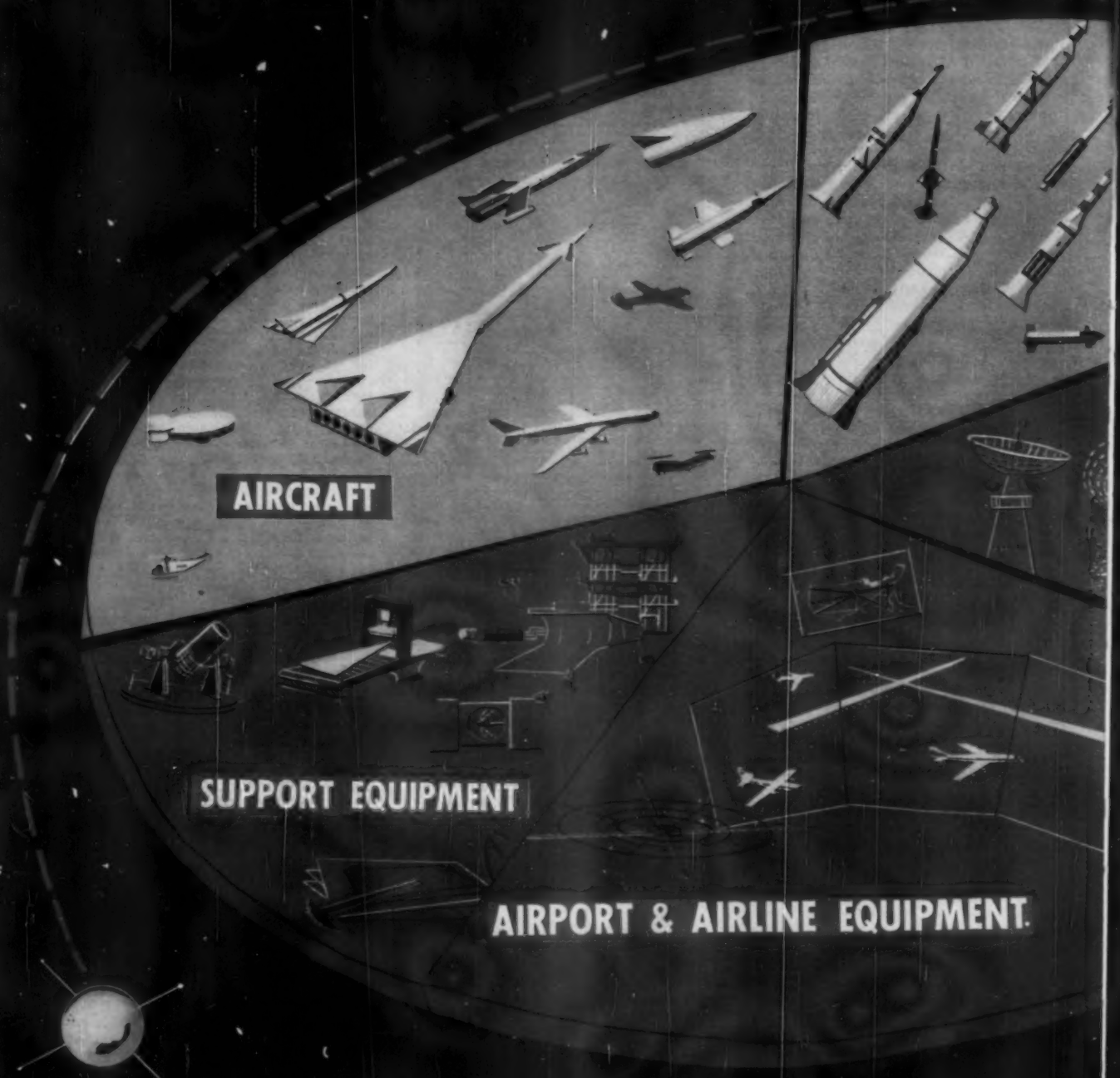

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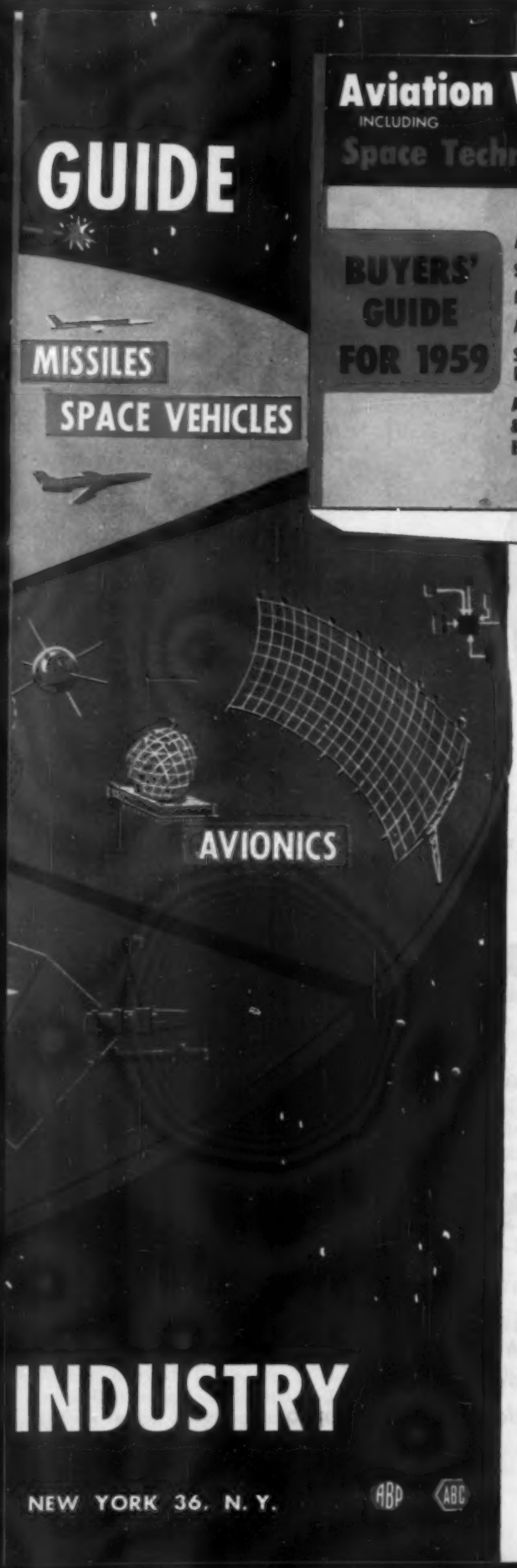

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WHO'S WHERE

(*Continued from page 123*)

Daniel E. Murphy, administrative manager, Datalab, a division of Consolidated Electrodynamics Corp., Pasadena, Calif. Also: **Everett J. Long**, director, Consolidated Electrodynamic's Transducer Division.

J. R. Daniell, manager-project systems branch, Lockheed Missile Systems Division, Sunnyvale, Calif.

Ray L. Reid, assistant chief engineer, Ling Electronics, Inc., Culver City, Calif.

Homer M. Sarasohn, director of engineering planning, International Business Machines Corp., New York, N. Y.

Allen M. Creighton, manager, newly established Combat Surveillance Group of Motorola's Western Military Electronics Center, Phoenix, Ariz. **E. J. Groth** will be group scientist and assistant manager.

John A. Rhoads, director of engineering, Technical Products Division, Packard-Bell Electronics Corp., Los Angeles, Calif.

Oscar B. Robey, head, Gyro Division, Motordyne, Inc., Monrovia, Calif.

C. P. Pesek, director, and **W. R. Ludka**, head, newly formed Missile Industry Liaison staff group, Minnesota Mining & Manufacturing Co., St. Paul, Minn. Mr. Pesek continues as vice president-engineering and staff manufacturing.

Dr. Carroll Barrack, manager, Electronics Dept., Miller Research Laboratories, Baltimore, Md.

Roy Hock, chief engineer, Technitrol Engineering Co., Philadelphia, Pa.

Saul Padwo, assistant to the vice president, Yardney Electric Corp., New York, N. Y.

E. W. Jacobson, system director of operational control, Trans World Airlines, Inc.

Edmund D. Lucas, Jr., systems application engineer, Special Products Division, Leach Corp., Compton, Calif.

Walter Krug, chief manufacturing engineer, Republic Aviation Corp., Farmingdale, N. Y. Also: **Edward Donald Jergens** now a pilot for Republic's Helicopter Division.

Joseph M. Cahn, chief engineer of the newly formed Military Products Division, Benson-Lehner Corp., Los Angeles, Calif.

Philco Corp.'s new Western Development Laboratories, Palo Alto, Calif., has announced the following technical staff appointments: **Paul Atkinson**, to direct the Human Factors group; **Wade H. Cone**, manager-field operations; **Royal V. Howard**, manager-operations in Hawaii; **John C. Keyes**, manager-program planning and integration; **Jack H. Pfeiffer**, manager-mechanical design and services.

Walter Serniuk, manager, Amherst Engineering Laboratory of Sylvania Electronic Systems, a division of Sylvania Electric Products, Inc., Williamsville, N. Y. **Robert F. Schulz** succeeds Mr. Serniuk as manager of the Reconnaissance Systems Laboratory of Sylvania Electronic Systems, Mountain View, Calif.

Dr. Raymond K. Masnaghetti, engineering consultant in the Development Division, Stavid Engineering, Inc., Plainfield, N. J.

Frank Herron, department head-scientific programming and analysis, and **Floyd E. Kelley**, department head-digital computing, Temco Aircraft Corp., Dallas, Tex.

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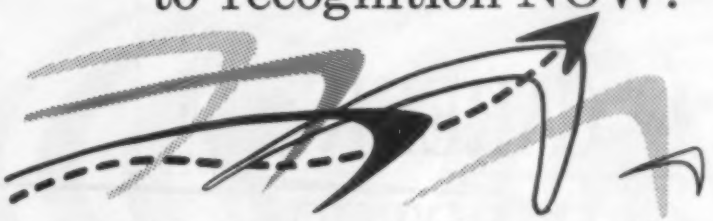

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STRUCTURAL ANALYSIS SECTION SUPERVISOR with 8 to 10 years experience, including supervision, in the missile field. Graduate degree for design and analysis required. Will be required to apply knowledge of high temperature materials and methods, thermal stress, dynamics, etc. to advanced hypersonic vehicles, re-entry bodies, and space vehicles.

FLIGHT TEST & INSTRUMENTATION ENGINEERS with 5 to 10 years experience in laboratory and flight test instrumentation techniques. Will develop techniques utilizing advanced instrumentation associated with space vehicles.

THEORETICAL AERODYNAMICIST. Advanced degree and at least 5 years experience in high-speed aerodynamics. Knowledge of viscid and inviscid gas flows required. To work on program leading to advanced missile configurations. Work involves analysis of the re-entry of hypersonic missiles and space craft for determining optimum configuration.

DYNAMICIST. Advanced degree, applied mathematics background, and experience in missile stability analysis desirable. Work involves re-entry dynamics of advanced vehicles and dynamic analysis of space craft.

ENGINEER or PHYSICIST. With experience in the use of scientific instruments or making physical measurement. Work related to flight test and facility instrumentation. Advanced degree desired with minimum of 3 years of related experience.

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NORTH AMERICAN AVIATION, INC.

LETTERS

Russian Engine

Regarding the current interest in developing million-pound thrust engines, an extract from the Russian press has recently come to my attention. In the April, 1958, issue of "Vestnik Vozdushnovo Flota" appears an article entitled "Some Problems of Rocket Technology," written by a Major General Mel'kumov. On p. 81, the author writes, "The thrust of a contemporary single liquid-fuel rocket engine reaches (a value of) 450 (metric) tons." At 2,200 lb./m. ton this comes to about one million pounds. Specific inclusion of the word "single" (edinichnovo) seems to rule out a ganged engine, and indications would seem to be that this motor was at least in the testing stage when this article was written.

Stanley Ross
Lockheed Aircraft Corp.
Missile Systems Division
Sunnyvale, Calif.

Painful Reality

From a score of publications this subscriber selected Aviation Week as the one most capable of providing high level educational reading which is so necessary in keeping abreast with rapid developments in aviation. Hence it has been disappointing to read several published letters from disgruntled and highly misinformed writers. From a reader's viewpoint, there would seem to be little difference between an anonymous letter and one written by a writer who withholds his name. In either case the writer wishes the safety of anonymity for making a cowardly ambush from which to take a verbal pot shot at someone with no risk of reprisal. As Editor, you could better employ your worthy publication than to print such unChristian, undemocratic, and unqualified venom.

Latest of these poison pen letters dignified by Aviation Week, bearing the ridiculous title "Swivel Necking" (AW Aug. 18, p. 118), is from a brash young Navy Lieutenant from Oxford, Miss. In his venomous diatribe, this boastful tyro draws upon a background of (sic)" . . . flying for two and one-half years (of my 10 years of Naval flying) as an instructor . . .", apparently not realizing that he is defaming literally thousands of dedicated pilots who had backgrounds of from 15 to 20 years in the highly specialized airline flying before he made his first solo. From the vantage of anonymity, the Lieutenant snipes at the high salary of the airline pilot with blissful ignorance of facts and the irrefutable laws of economics. In terms of an unreliable rubberized dollar, the unit cost of air transportation has been reduced drastically while the costs of living have soared upwards for all airline employes. Hence, real income today of the airline pilot for flying highly complex aircraft is actually far lower than 15 years ago when he flew the much simpler DC-3.

The swivel-necked self-styled expert refers to ". . . the window the aircraft manufacturer so conveniently placed close to your seat," yet seems unaware that this windshield has almost exactly the same size and scope as was designed for the Ford tri-motor of 30 years ago. The aircraft manufacturers (so conveniently) persist in ignoring the fact that the pilot of a 300 mph. plane today still may see less than 15% of the total spherical space in which the pilot sits at the center. Thus 85% of this total area remains completely blind to the pilot, insidiously including those areas above and below into which the pilot is expected to direct his plane in making the necessary VFR climbs and descents.

With an irresponsible scatter-shot of venom splattering one and all, the Lieutenant exposes his ignorance to those armed with truth by his implication that the airline pilot spends his flying hours reading funny books. Ironically, he touches closely upon a painful reality that has little to do with funny books. The pilot today must sit with his manual and abstruse navigational charts on his lap, poring over details in fine print under the poorest of lighting conditions, too often so busy with traffic control instructions, navigational aids, and radio frequencies to have the time in which to monitor that 15% of air space visible to his sight.

If, in a spirit of fairness, it is decided to print this rebuttal, it would probably not erase whatever stain this young fledgling was able to smear, with his scurrilous letter, upon the many thousands of reputable airline pilots. Fortunately, your publication is of a standard that most subscribers will easily penetrate the immaturity of the Lieutenant's perspective. Having difficulty climbing the steep ladder of success, he would make the ladder shorter.

Criticism is easy—accomplishment more difficult.

This is an age of specialization wherein there are dozens of wholly dissimilar flying occupations. Many of us have struggled for over a quarter century with perplexities and incongruities of the IFR/VFR traffic control system, and would humbly appreciate any worthy, constructive criticism. Transparently, the Lieutenant offers—exactly nothing!

Clarence W. Hudson
United Air Lines
Los Angeles, Calif.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Marquardt Ramjets

Reference is made to the article "USAF's Bomarc Readied for Shipment to Eglin Range," which appeared in the Aug. 18 issue (p. 58) of Aviation Week.

In this story appears the statement: "Super Bomarc IM-99B, slated for operational use in 1960, will have a solid-rocket sustainer engine." If you interpret "sustainer" to mean boost, this is a correct statement. If, however, you are referring to the cruise capabilities of the IM-99B, a pair of Marquardt Mach 4 ramjets will supply this power.

The following excerpt from an April 3 news release from Boeing Airplane Co.'s Pilotless Aircraft Division may help clarify the matter:

"Boeing Airplane Co. confirmed today that it plans to use new ramjet engines which have been tested by Marquardt at Mach 4 speeds and 100,000 ft. altitudes to power the advanced IM-99B Bomarc missile which it is developing for the U. S. Air Force."

The situation may be further clarified for you by quoting from the April 7 (p. 30) issue of Aviation Week in which it was stated:

"Improved (Marquardt) ramjets developed in the program for the 400-mi. range solid booster Super Bomarc have been test flown on Lockheed's X-7 ramjet test vehicle at Mach 3.95 and at altitudes higher than 100,000 ft. Maximum speed for the current Bomarc is Mach 2.5."

What your Aug. 18 article should have specified is that solid rockets will provide the boost, and Marquardt advanced ramjets the cruise power for Bomarc IM-99B. We would appreciate such a clarification.

Jack Anderson, Manager
Public Relations & Advertising
Marquardt Aircraft Co.
Van Nuys, Calif.

'Grand Little Missile'

You print a fine magazine and have a lot of good stories in it, however, sometimes you have a story in which you do not know what you are talking about. Even though this letter is rather late it might help you from making the same mistake about the Nike Ajax missile. In your Sept. 30, 1957, issue, you had an editorial entitled "Perspective on Missiles." In this story you stated that the Nike Ajax at its very best could only bring down piston-engined bombers. The Nike can destroy ANY operational aircraft at any speeds up to Mach 2. You also stated that the billions poured into the Nike Ajax system was a classic example of military waste through stupid planning. In this case the only ones that are being stupid is this magazine for saying such a thing.

You also stated that the Nike Ajax isn't in the same ball park as the F-102 and the F-89 armed with the MB-1 atomic air-to-air missiles when it comes to knocking down enemy bombers; that is a lot of —.

I am only 14 years old but my father used to command a battery of Nike's before he was made operations officer at the 531st AAA. He read your story and thought it to be very stupid. He said, "Every airplane and missile does an important job in the Air Defense Command and the Nike Ajax has a vital job protecting America. Every missile and airplane has its limitations and that includes the Nike also."

It is my hope that you will print a story of the Nike as it really is, one grand little missile. Thank you for your time.

Robert G. Hoehn, Jr.
Ellsworth AFB, S.D.

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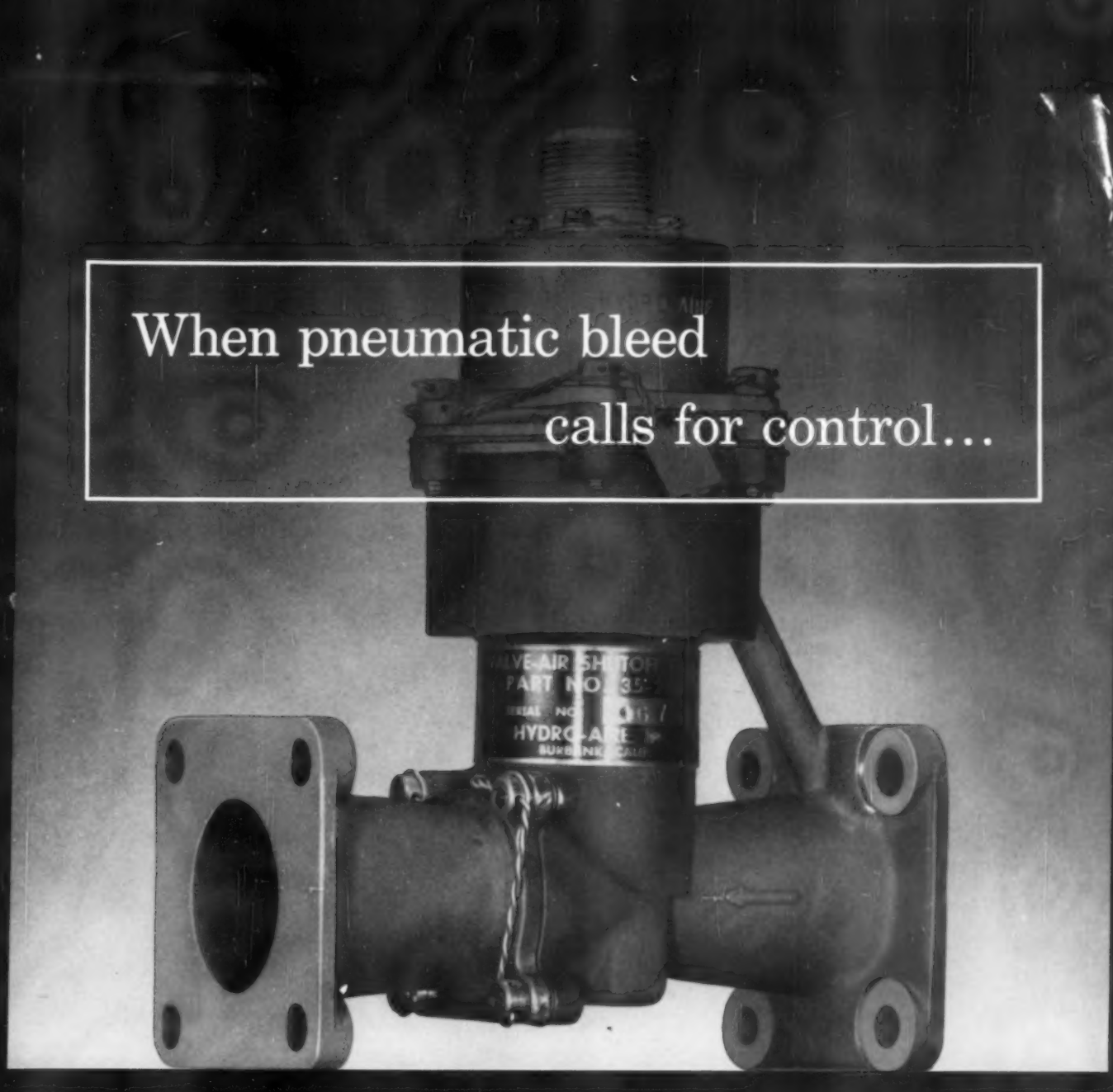

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